SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, FEBRUARY 15, 1907

CONTENTS

Relations of Salary to Title in American Universities: PROFESSOR JOHN MAXSON STILLMAN 241

The American Association for the Advancement of Science:—
Section G—Botany: DR. TRACY E. HAZEN .. 259

Scientific Books:—
Marchal's Recherches expérimentales sur la sexualité des spores chez les mousses dioïques: DR. A. F. BLAKESLEE. *Peglion's Le malattie crittogamiche delle Piant coltivate:* HAVEN METCALF 272

Scientific Journals and Articles 274

Societies and Academies:—
The St. Louis Chemical Society: DR. C. J. BORGMEYER 274

Discussion and Correspondence:—
Genetic Logic: PROFESSOR J. MARK BALDWIN 274

Special Articles:—
Symmetry in the Big Claws of the Lobster: PROFESSOR FRANCIS H. HERRICK 275

Current Notes on Meteorology:—
The Weather of Saxony; Railroad Building in Arid Regions; Meteorology in Egypt; Rainfall and Altitude; The 'Scotia' Results: PROFESSOR R. DEC. WARD 277

Mr. Rockefeller's Gift to the General Education Board 278

Scientific Notes and News 279

University and Educational News 280

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

RELATIONS OF SALARY TO TITLE IN AMERICAN UNIVERSITIES[1]

IN this paper is considered the problem of the relation existing between salary and title, under the conditions ruling in American colleges and universities. What adjustment of these relations is most favorable to the effectiveness of the institution concerned? In general, three types of adjustment are possible. In the one case, a fixed salary may be attached to the professorship and to each of the lower grades of rank. Next, each grade may have a fixed minimum salary, with a system of automatic increase with length of service, and for no other cause. The third relation is the one generally prevalent; the salaries in any grade are not definitely fixed, and increase of salary may be made at any time and for many reasons other than those connected with length of tenure.

The first of these systems aims, so far as professors are concerned, to establish a republic of letters. It would develop a condition in which a man once chosen for a chair is responsible to no one but himself, and in which he neither expects promotion nor fears its failure, because his character and work are judged by no president, no committee and no executive board. The men in minor positions are professors in waiting, to receive recognition in case of vacancy or of departmental expansion.

[1] A paper read at the Cambridge meeting of the Association of American Universities, November 23, 1906. The paper was prepared by John Maxson Stillman, professor of chemistry in Stanford University.

These again are held on an equality pending the opportunity to rise to greater responsibilities and greater remuneration. The second system is a modification of the first, with the added recognition of the fact that, with university men, the expenses of living increase with the years. The third system considers the problem from the standpoint of the efficiency of the university organism and of the actual value of the professor to his students. In it, the element of competition appears, and the greater pecuniary reward goes with the greater academic service. The first and second systems imply a static organism, a university with its form and scope fixed once for all, and the professors as incumbents of established positions. The third system is dynamic. It implies the growth of the university organism, and the value of personality as a factor in different phases of growth.

Taking universities as they are, the institution is not a republic of letters on the one hand, as there are students as well as professors to be considered. On the other hand, it does not find its homologue in a great business enterprise. It is not alone what the members of the faculty do, but the ideals they represent, which is important.

In the practical discussion of the first and second of these systems, we may assume that if promotion is impossible or automatic within the grade, the promotion from one title to another is not likewise automatic. In such cases there would be no possibility of any discrimination between men of different value except by the difficult method of dismissal of such as fail to reach the plane of efficiency desired in the highest positions.

One of the most obvious arguments in favor of like remuneration for equal grades is that it relieves the university authorities from the difficulty of attempting to assign different money values to services extremely difficult, even impossible, equitably to appraise. No university president and no board of trustees, nor indeed any other body of men, can have the intimate knowledge of the values of the services of men in a university faculty adequate for the establishment of just discriminations in salary on the basis of service rendered. Even if we assume such intimate knowledge, we are at once confronted with even greater difficulties of establishing the standards of judgment as to the value of these services. The elements entering into the value of a university teacher are many;—*e. g.*, originality, scholarly productivity, teaching capacity, industry, energy, personal influence, character, executive capacity. Different men place the emphasis very differently on the relative value of these different qualities, and agreement as to their relative importance is impossible. Such being the case, discriminations in salary between men of approximately equal standing can not be equitably administered.

When, therefore, it is attempted to establish such discrimination, there results dissatisfaction in the faculty. Faculty members criticize the discrimination in the light of their own knowledge of the men and their work and according to the emphasis they place upon their various qualifications. This engenders jealousies and gives rise to attempts to influence the president to recognize the claims of individuals, and cliques and factions are created. Stimulated by the uncertainties as well as by the possibilities of the shifting basis of salaries, political methods, personal influence, and 'wire-pulling' become prevalent. Discontent, lack of harmony among the faculty members, and between faculty and president, are the natural consequences. The president is charged with favoritism, and professors are accused of

exerting undue influence on behalf of their own interests or of the interests of their friends or favored subordinates. I have endeavored to present this argument strongly, and we must admit that there is justice in the objections to the attempt to estimate closely the values of men by difference in salary.

On the other hand, if we admit that harmony would be promoted to a certain extent by the same pay to men of the same title, we must consider at what cost this harmony must be secured.

The above argument depends for its validity upon the assumption that the pay is an important element in the ambition and desires of the university teacher. It would be strange if it were not. Uniformity in pay, if it is to be a satisfactory condition, assumes at least approximate equality of value to the university. It is very evident that no such condition exists in any university faculty. In any faculty there are wide differences in the value of different men to the university, whatever criteria of value may be assumed. It is neither fair nor just to expect men of exceptional value to be satisfied with salaries paid to men of distinctly inferior academic value. There is injustice in not recognizing increasing influence, scholarship and general usefulness by commensurate increase in salary. Nor should it be necessary to pay men of mediocre value the higher remuneration which is fairly deserved only by the strongest men.

If it be argued that none but men of approximately the same ability and value should hold the same rank, it can be asserted that such a condition is practically unrealizable, as may be easily verified by considering any given faculty. It is a matter of greater difficulty for a president and trustees infallibly to select the strongest men only for professors, than it is to properly appraise their services when in the university service. Appointees do not and can not equally fulfill the hopes and expectations under which they were appointed, but once appointed they can not be summarily dismissed to make place for greater men, so long as with a fair degree of scholarship, industry and devotion they pursue their career; but there is no justice in paying such men the same as ought to be paid to those who are of distinctly higher value to the university and to scholarship. Furthermore, when a man by reason of merit attains a full professorship early in life, if he feels that thereafter with moderate attention to duty his salary is assured without hope of increase on the basis of value rendered, an important incentive is lost to him for his future progress and development. He is deprived of a stimulus to activity and ambition not without its influence upon common human nature even in academic circles.

There is also the more utilitarian idea of supply and demand which must be taken into account. No university has unlimited means at its disposal, and the problem of administration is to perform the most effective service for education and the increase of knowledge with the means at its disposal. To fulfill its responsibilities to its students and the public, it must secure and hold the most efficient men possible. If the law of supply and demand sets unusually high the value of the good men in certain lines, or the value of exceptional men in any line, it then becomes the duty of the university to pay some men salaries which it can not afford to pay to all.

It may be claimed, on the other hand, that university teachers do not and ought not to enter the career for the commercial value of the position. The world offers other opportunities for those who seek large incomes, and the university teacher who is fitted for the work looks to enlarged oppor-

tunities for study, research, and to the love for his work as a teacher for the rewards of his success rather than to financial rewards. This is unquestionably true to some extent. Nevertheless, within the limits of salaries at present existing in the universities, the fact remains that university teachers are appreciative of and desirous of such increases in their remuneration as lie within the range of present possibilities in any university. Until the range of university salaries is distinctly higher than at present, university teachers will find that the minimum salaries paid in any institution are not so large but that they are compelled to deny themselves and their families many reasonable comforts and luxuries which are greatly desired by all people of similar culture and social status. And so long as this is true, the university must face the necessity of competing with the world outside for the services of thoroughly competent and ambitious men in many lines. For the less wealthy universities particularly, the competition for the best teachers would under a fixed salary scheme render it impossible for them to hold their strongest men, if to do so they were compelled to pay an equal salary to all holding the same title.

In consideration of all these factors in the problem, is it not probable that the gain of simplicity of administration and some measure of harmony in the faculty by the system of equal pay to equal rank would be made at too great an expense of efficiency?

We must not overlook the fact that if equal pay to equal rank were the rule, discriminations would still have to be made in the matter of promotions from one grade to the next. In promotions, not only the pecuniary consideration is concerned, but a public honor is conferred. Precisely the same variety of considerations enters into the qualifications for promotion as into salary differences. The same lack of agreement as to what relative weight should be given to teaching power, productivity as a scholar, personal influence and character, etc., exists here, and the same possibilities of jealousies, suspicions of favoritism, 'wire-pulling' and personal influence. The writer is inclined not to lay great emphasis on the dangers of such influences as necessarily incident to either system under discussion.

Wherever discriminations have to be made into which enter estimates of the relative values of such services, whether by differences in pay within the same grade or by promotion, there is bound to be some dissatisfaction and discontent. A just and wise administration will reduce these evils to a minimum by inspiring the faculty generally with confidence in the fairness and general good judgment with which such discriminations are made. Entirely eliminated, dissatisfaction and discontent can never be. At best they can be confined to those members who differ with the constituted authorities as to the relative value of their services, and, perhaps, to their particular friends. Under either system these administrative difficulties will exist and remain the same in character though differing possibly somewhat in degree. These difficulties will be lessened to a great extent by avoiding the making of small differences in pay between men of the same rank. For while the reasons may be readily apparent to the university community why a considerably larger salary must be paid to certain individuals, it will be much more difficult to justify small differences in salary to men of the same rank. For small differences in general usefulness or value to the university it will be admitted are not possible of fair estimation. They are not justified either on theoretical or on economic grounds. They tend toward discontent and irritation without material

saving to the university treasury, and they can not command the general approval of the university public. When certain men stand out so prominently as to deserve to be recognized by the authorities by a larger reward than their associates, the university community generally recognizes the fact, but the reasons for such recognition should be such as to be clearly recognized. Where, however, such is not the case, then equal pay to equal rank is the safer and fairer basis. The practical working out of the salary problem to my mind should be on some such lines as the following:

Each grade or title should have a minimum salary pertaining to it. This salary should be large enough to insure comfortable living with due regard for the reasonable demands of cultured taste. Much discontent arises because the minimum salary of the various grades is often so low that men can not live as the requirements of their profession and social status demand. This inadequate minimum compels the authorities to make advances of salary to meet personal necessities, which are not always justifiable on the grounds of relatively greater service rendered. Appointments to the lower ranks should be probationary and the university should be considered perfectly free to terminate such positions, to continue them, or to promote to a higher grade in due time. Within each grade certain allowances of increase in pay should be made for length of satisfactory service. Above these minimum salaries there should be the power to advance the salary of any man when it is clearly for the interest of the efficiency of university work to do so. Generally speaking, the maximum salary of one grade should be less than the minimum of the grade above, though even here it is imaginable that a departure occasionally from this rule might become a justifiable exception. In each grade the authorities should have the option of leaving a particular teacher undisturbed at the minimum of his grade and time of service, or of advancing him in recognition of extraordinary ability or unusually valuable service. They must also have the option of promoting or of passing by any individual. according to his deserts or the university's needs. In the lower grades, below that of professor, while the deserving character of a member must be considered, it must also be kept in mind that the scope of the university work and the financial limits of the university may prohibit promotions even when fairly deserved. Even very good men must often look abroad for their promotions. In the higher grades it is assumed that permanency of position is reasonably assured, and this should guarantee the minimum salary of the grade and time of service without any presumption of further increase unless fairly won by unusual distinction and recognition; but the university should then be free to recognize such service freely, both for the encouragement of scholarly ambition and to be able to retain its strongest men.

Briefly summarized, we may say that the maximum efficiency of the university work and a minimum of administrative difficulty resulting from inequalities in pay in the same grade, will be attained by a minimum or normal salary for each grade large enough so that men of reasonable desires may live and do their work and maintain their families without worry and discomfort; by reasonable increases dependent upon length of efficient service, and with freedom to recognize unusual ability or distinguished service as the requirements of the case may demand. Such recognition, however, should be made for reasons, the reasonableness of which should appeal to the university faculty generally.

Upon the assignment of this topic to Stanford University, President Jordan is-

sued a circular letter to many presidents and faculty members asking their opinions upon the question involved. At the time of writing some hundred answers have been received. The limits of time prevent the writer from obtaining permission to quote over their signatures the many interesting answers. I append, however, quotations from some of them that are typical of certain classes of answers and which will supplement the above brief discussion. Of sixteen college or university presidents, fourteen are opposed to equal pay for equal rank, one in favor, and one answer not decisive. Of eighty-one faculty members, sixty are opposed, seventeen in favor, four gave no decisive answer. Some thirty-three emphasize the value of an established minimum for each grade, increases above which may be made for good reasons, as length of efficient service, unusual ability or general usefulness.

John Maxson Stillman
Stanford University

The following quotations are from presidents of universities:

1.

I am firmly of the belief that there should be no rigid salaries payable to all men in the university bearing the same title. In other words, I believe that the university should pay what it thinks a man is worth. If a certain department is in need of a very eminent man, it would be wise for it to pay him double the salary ordinarily given. I believe that the principle should be variation, according to ability and experience, and quality of usefulness to the institution at any given time.

2.

In my judgment, while the salaries of professors in any institution will naturally gravitate toward some given figure, I see no reason why there should not be deviations therefrom, due to the greater value to the university of some men over others or the need of larger compensation to retain such men in the service of the university. In the case of assistant professors and instructors, who are appointed for a fixed period of time, I see little, if any, objection to uniformity of salary.

3.

Sitting in an easy chair, one can argue one's way with perfect satisfactien to one's self up to the conclusion that all men having the same title should have the same salary; but I have never been able to manage a university on that principle, and I have never been able to acquire such ability. Extraordinary things are always coming in to interrupt in the application of the theory. We have here assistants, instructors, assistant professors, professors, head professors, deans, president. Some of the instructors get as large salaries as some of the assistant professors; some of the assistant professors get as large salaries as some full professors. Where action is in our hands, we prefer, within reasonable limits, to increase salaries rather than titles. Sometimes, however, a man insists upon an increase of his title, and to refuse him means to lose him whenever a good offer comes from another institution. Sometimes it is possible to increase a title and to promise the increase of salary on and after a certain date when additional money is expected. Some men insist upon increase of salary more than upon increase of title, and *vice versa*. Sometimes you must increase the salary and title both.

I need not point out that the case does not occur in which an assistant gets as much salary as an assistant professor; nor a case in which an instructor gets as much salary as a full professor; but instructors and assistant professors do run together sometimes in respect to salaries; and so also assistant professors and professors in some instances.

4.

I beg leave to say, 'No.' The reason of the answer seems to me to be summed up comprehensively in the remark that men, even college professors, differ in character and efficiency. Therefore, the pecuniary recognition may fittingly vary according to their work and worth.

The individual and not the institutional method should prevail. It is much easier to administer a college on the basis of the same compensation for men of the same professorial grade; but I believe that such administration is not wise either for the individual or for the institution itself in large relations, or fitted to promote the higher interests of the whole community.

5.

I know of no solution of this problem which seems to me entirely satisfactory.

There are those who think that a fixed system or scale of some sort should be adopted and followed. That would be the easiest plan for the trustees and the president. Perhaps it is the right plan. But after the most careful consideration it does not seem so to me. I do not find any institution such as ours where any fixed system has been found practicable, though various systems have been given trial.

A fixed system of promotions and salaries is said to work well in the army—in time of peace. In time of war it is in the army as in all other callings—the system must go to make way for the most efficient service.

Aside from the differences between men, which count in every occupation and must count among teachers as well as others, there are circumstances and conditions which vary from department to department and render a fixed system a heavy handicap upon the maximum efficiency of the university.

The university can not, for example, make nothing of the fact that it is very much more difficult to get good men in certain departments than in others. This fact constitutes part of the reason for one exceptional recommendation made at this time. In such cases the university can not afford to restrict itself artificially by a system.

On the other hand the conditions and circumstances in another department may make it extremely difficult to promote every worthy man. The commonest example, in the universities generally, is that of the department whose places are already filled by a practically permanent staff of good men. If one looks at the case of a single individual, relief seems easy. But some one must look at all the individuals. Some one must look at the budget for the year. Some one must consider what the budget will be next year and in the following years when outgoes are growing and incomes are standing still. In a word some one must consider the life of the university as a whole. When one does that, the problem of advancing all the individuals who deserve it appears not simply difficult but impossible. No university is rich enough to make places and salaries for all who deserve them. No university has a right to make place or salary for any man unless this is justified by the interests of the institution.

In fine, an automatic system is easy and peaceful. It relieves the trustees and the president from their most trying responsibility. But in my judgment it must again and again pay for this peace and pleasant irresponsibility by the sacrifice of essential university interests.

I believe that the trustees and the president must choose a harder and more troubled course. They must accept the responsibility of doing what they believe to be best and must abide the consequences to themselves and to the university.

I do not forget, as I write, the first-rate importance of a good spirit within the faculty. The maintenance of that spirit requires that the administration of affairs should be reasonable and disinterested. But if a reasonable and disinterested administration (which must often bring disappointments to individuals and which must sometimes make mistakes) does not develop a good spirit within the faculty, the whole problem seems to be hopeless.

6.

While there are diplomatic reasons for giving the same salary to men holding the same title in a college, there is no justice in it, as it is impossible to secure men of equal effectiveness in their respective positions. The question of administration is doubtless easier if professors are placed on equal salary, but there seems no sufficient reason to my mind why the laws of supply and demand should not be applied to college professors as well as in other walks of life.

7.

There is no reason why the same salary should be paid to men bearing the same academic title in other than the subordinate grades, such as assistant, tutor and instructor. I think that assistant or adjunct professors, and more particularly professors, should be compensated as individuals and not as members of a group, the amount of compensation to vary in accordance with particular circumstances affecting the nature, the quality, and the amount of their academic service.

The following quotations are from faculty members:

8.

For a categorical answer to the question I should say, *no.*

The dilemma which the question involves is in some respects similar to that which appears in the question of salaries for public school teachers, and is somewhat more remotely analogous to that which appears in the whole problem of appointment, promotion and salaries in the civil service. On the one hand, a mechanical uniformity is easy of administration and shuts out

the dangers of favoritism, wire pulling and the whole set of evils that are commonly described as political. On the other hand, such a system makes it impossible to adjust the external rewards of service to differences of experience, capacity and life-needs among those to whom the schedule of salaries applies. It may be taken for granted that there will be an upper limit of salary which will be low enough to prevent the position of instructor from becoming an object of covetous competition, and there will be also a lower limit which is not too low to enable a self-respecting man to live respectably. I can well understand that even within these limits there is danger to the scientific and spiritual interests of a university in a sliding scale which may seem to emphasize purely what may be called the market value of a man; but it should be remembered, on the other side, that a thousand differences of personal and family need, of general make-up and disposition, not seriously affecting a man's scholastic efficiency, and other differences too numerous to mention, are present and must be considered and ought to be considered when a man in a given institution is offered a higher salary in another institution, or in some other occupation for which his talents may fit him. Without entering into any unseemly competition on purely financial grounds, an institution may consider, and I think ought to consider, such differences, in adjusting the salaries of instructors within such limits as are suggested above.

There is not much danger that an instructor will work for money chiefly, or will get rich even if he does, but even in a university a man who renders services of extraordinary value should have a fair opportunity of receiving a larger income than another instructor of the same scholastic grade whose services are notably inferior to his. The difference in salary will not pay for the difference in service and can not be made to pay for it; but it may render the more useful man a little more free to make the most of his useful life by travel, by acquisition of the means of culture and research, and by the various other ways which are within the purchasing power of money; and it may render him better able to help his family and friends and those who have a right to look to him for help.

9.

1. I do not think that 'the same salary should be paid to men bearing the same title.' But this under the following provisos:

2. There should be a minimum salary for each rank, no less than which each appointee should receive upon his advancement to the rank.

3. There should also be a maximum salary for each rank, attainable by those members of the rank whose abilities and performance show that they deserve it.

4. Promotions within each rank should be upon proved merit, judged in the light of the quality of departmental work, and without reference to 'university politics,' or 'work' in the manipulation of committees—in short, the study or the courting of 'influence,' whether with authorities or with students. The rate, or rapidity, of promotion should correspond to the proved value of research and teaching service.

5. Advances in salary, as in rank, should be made in sole conformity with the advice of the president, and this advice should result from consultation with the department-head under whom the candidate serves, and should, unless there is clear adverse reason, follow the head's advice.

10.

My feeling is decidedly in favor of *equal* salaries, as tending to greater unanimity of feeling among professors, and so to greater loyalty to the university. Equal salaries seem to eliminate, so far as possible, the whole element of *favor*—the *personal* equation—and this sets every one free to do his best, according to his light, for the university. Equality, too, removes the possibility of bargaining, of jewing up or jewing down a salary, according to the exigencies of the moment. This policy, too, seems to me to be, in the long run, the more dignified for the university. A man comes to it, not because he is bought at a high price, but because the university *as a whole* suits him. He takes his place in the equal brotherhood of professors, feeling that his fortunes are bound up with theirs, and so with the fortunes of the whole university. * * *

Of course equality of salaries will occasionally prevent a university from securing an able man who might have been secured by 'subsidizing' him—and it will result in some men being paid more, and some less, than the market will bear. * * *

Of course this preference for equality does not preclude an advance for years of service, so long as the advance, as at Harvard, is automatic, so to speak, and not a thing to be bargained for, or begged for. (I have heard of one interior university where advance of salary must even be 'toadied' for.) * * *

And yet in the long run I am convinced that

equality of salaries tends to contentment, to fraternity of feeling, to loyalty, and to the minimizing of the force of the mercantile spirit in a faculty. * * *

My argument is intended to apply chiefly to full professors, the 'peers of the realm.' There is no objection to a money stimulus to the men who are still on probation, with their spurs to win.

11.

1. It is necessary, in my opinion, to separate the college of arts and sciences from the technical colleges in the discussion.

2. If there were sufficient men who were *called* to teach in the sense that the old apostles were called for their work, then I believe that there would be no question of diversity of salary. All that would be needed would be barely enough to keep soul and body together.

3. While there are plenty who would like the call of a university there are not enough with '*the call*' to fill college positions. This puts the colleges in the field of competition with the practical world for the all-round, capable and forceful men who are not satisfied, on the one hand, with the dead level of communism or, on the other, with things as they are and have been. Progress and experiment to attain that progress is their motto. Now to get these men to put their courage and force to the service of a college, the college must offer them something like the chance they would have in the great world, that is, a chance to receive the reward to which their force and courage entitle them.

4. To obtain the men with the force and courage which shall make the university a real and living part of the civilization of the time, the university must—in a measure at least—appreciate the reward which is offered by the world for the kind of service it desires. There is no doubt that money at the present time is taken as the measuring stick of men. Money certainly makes it possible for men to attain much which is most desired by them and their families.

After men have once caught the divine fire which comes to the college teacher, money questions would not so much affect them; what I am contending for is that the university get the forceful characters into its faculty by offering rewards which will attract them. It can not afford to be manned by those who can not get a living so easily any other way.

5. *Technical Schools.*—The same general statements may be made as with reference to the college of arts, but here the university comes into more direct competition with the practical world. If the technical school is to be an integral part in directing the progress of the civilization of our time the men who form its faculties must be among the chosen—men with strong character, clear heads and the courage and foresight to make the necessary advances. Then the schools could hope to be leaders instead of mere trailers.

Now to get a sprinkling at least of the real leaders there must be provision in both salary and rank. And the salary in the technical school must average considerably higher than in the college of arts.

6. Just the method to pursue to attract into the teaching profession the all-round, forceful men so much needed in colleges may perhaps be answered by creating special positions with corresponding salary—such as head professor, dean, director, etc. This might leave the rank and file in a group with uniform salary and therefore without one element of discord.

7. In closing then I would say that in the modern university there must be diversity of salary and rank in each college and a distinction between the college of arts and the technical schools.

While it may not be germane, I would like to put in a plea for appreciation of the teacher who is really *called*. He, after all, is as much needed as the one who can do magnificently anything he puts his brain and hand to. Money is usually much less prized by him than opportunity for study, for investigation in his chosen field.

12.

Apparently it is not practicable to pay the same salary to all men holding the same rank in a faculty, and yet a wide departure from this policy seems to work great injustice in many cases. I once believed that a university president should be free to pay whatever salaries he found necessary to secure the men he wanted, and that salaries within the faculty should be based entirely upon efficiency. I have now come to regard the other extreme, with an absolutely fixed scale, as preferable to this method.

No man is omniscient, nor can any man know with a higher degree of approximation the relative efficiencies of the men in a moderately large faculty. Even the men in the same department or in closely related departments differ widely in their estimates of any particular man. One lays the stress on one qualification and one on another. Hence, while no individual is competent to pass upon the salary scale of a whole

faculty, no group of men will come to any agreement upon such a scale.

Most men are so constituted that their opinion of the qualifications of others depends largely upon their personal likes and dislikes (I know that I am personally very strongly influenced by such considerations), others are so constituted that they yield to persistent pressure on the part of one who is working for an increase of salary, and still others may be influenced by the cliques which are always formed in a faculty for the purpose of boosting their members. Hence, whenever a man receives a higher salary than others whom the general consensus of opinion would rank in the same class, there are apt to be charges of favoritism or 'pull.' In this way, the influence of the president who has the fixing of salaries is bound to be greatly weakened. * * *

Again, assuming that a man of absolutely impartial mind and of wide information could be given the authority to fix salaries, there is no general agreement as to the grounds upon which distinctions should be based. One man is an excellent teacher and exerts a great influence upon the lives of his students; another is a great investigator and does not know the names of his students. Which should receive the greater salary? Most men are neither great teachers nor great investigators, but one excels in some particular and another in something else. How shall we say which is entitled to the greater salary?

I am aware that absolute uniformity is impossible, even if it were desirable. Certain departments are compelled to pay more for men of equal ability and preparation than other departments. At any one time, there are living in the world only a few first-class men in any profession and a university which is able to afford the luxury of such a man should be compelled to pay for it. However, the total number of such men in the world is not large enough to make it necessary to take them into consideration in deciding upon the general policy of a university. So I believe that university salaries should, as far as possible, be fixed upon an arbitrary basis, taking into consideration the rank and time of service of the men, and that departures from this fixed scale should be made only for weighty reasons, reasons which would be recognized by the faculty as a whole.

13.

I may now say very briefly that I think university teachers of the same title should not receive the same remuneration. With such a plan I believe we would have too serious an interference with the great law of supply and demand. In our academic guild there are already too many impediments to the free working of the law of the 'struggle for existence and the survival of the fittest.' The principle of the 'redemption of the unfit,' which our too pious altruistic brethren are introducing as a counter law to the law of evolution, is being overworked in these times.

Everywhere in life, a man should be paid what he is worth. I know that many of my colleagues say that this would introduce commercialism into university life. It is often said that university men can not do their best work if they have to be continually thinking about their salaries. This is in one sense profoundly true, but I believe that it is often the argument under which idlers take refuge.

14.

Fundamentally, a sharp distinction must be recognized between the academic and the administrative requirements of the institution. This underlies the question at issue. The university is required to exist in a commercial world, and meet financial conditions on a commercial basis, while, at the same time, it must meet its obligations to the ideals for which it stands. The university thus is forced to maintain its standards at variant costs, and direct its progress by paying prices that it does not itself control, when they are disproportionate to the true academic returns. This is because of the outside standards of value, which do not accord with the necessary ones within. The discrepancy holds true for every item of expenditure, and among the other items are included the salaries.

There then arise two classes of considerations for which salaries are paid. One is that for services which perhaps have little or no commercial value, rendered by persons who are thoroughly dependent upon college interests and college standards. The other is for services purposely attracted away from commercial competition by liberal payment. The two classes, or purposes, are separate and must be regarded separately; for they are made necessary by different causes, they administer to different needs, and they bring about different results. One is strictly academic, and the other is thoroughly commercial; and each is a factor in practically every salary.

The true academic purpose is steady, continuous, uninfluenced directly by commercial considerations, and ultimately is desirable. Such services are easy to grade. Salary in that case

conforms closely to title; and acting with title it becomes an expression of university approval and merit.

Commercial considerations, however, can not be bounded so. The commercial purpose is fluctuating, insincere in the college field, and rests upon a commercial basis and outside standards. It is always subject to influence acting on the outside, and these break into any desirable order of things within.

Therefore, when necessary, commercial influences should be met according to their demands, not restricting or limiting the power of the university to do this, but observing its best interests while protecting its standards. The salary is the means that makes the fulfilment in that case possible and is the only compensation the college can afford to offer commercialism. It could be shown, on the whole, to be unwise for a university to go far into extreme commercial competition for men, and deal in such commercial margins upon men as have accrued from popularity, or from success in some one line of commercial activity.

Thus salary, in part, must be held under a commercial standard, while title always must be considered under an academic one. The two standards do not conform, and no effort could draw them naturally together in defiance of commercial law and custom. A uniform scale of salaries, graded according to title, or defined by the title, is an ideal to be approached as closely as outside conditions will permit. Such uniformity, however, is not sufficiently supple for working purposes; and for practical reasons, the best results are obtained by a moderate departure from it in different ways, limited not by defined bounds, but by conservative administration, retaining always the ideal in view.

15.

Let me say in answer to both questions that I think the same salary should not be paid to men bearing the same title. There should be an identical minimum salary to be paid to all men bearing the same title with such additions in individual cases as the university may deem wise, in order to recognize the moderate natural increase, up to a certain limit, which ought to be given to all members of the faculty who do faithful service, and the exceptional increase which ought to be granted to men of exceptional value.

16.

The question strikes me as scholastic.

University organization can not be modeled upon the army. The best interest of university service prohibits that it should be enterable only at the bottom. University professorships high and low should be open to competition. Professors do not need the shelter of benevolence nor to be entrenched behind the contract esteem of benefactors. Universities should be free to get the best men their resources will command. Hence no rigid connection between title and salary roll is advisable.

17.

I beg to offer as my opinion:

That the same salary should not be paid to men bearing the same title. I feel that in the lower grades of the instructing force different sums should be paid according to the character and amount of work. In the grades of instructors, assistant professors and associate professors I think there should be a minimum and a maximum limit—that in general, advancements or appointments should be made at the minimum figure, and there should be a regular automatic increase in those salaries until the maximum limit is reached; then it may be desirable to retain the person at that salary either permanently or for some time, until he has shown his qualifications to be raised to the next grade.

When it comes to the full professorships, I think again there should be a minimum salary, and that the advancement to what might be termed the 'regular' salary of full professor should be, as in the lower grades, automatic and regular; that above the regular salary there should be exceptions made upon the sole consideration of the value of the individual to the university. That means discrimination, and I believe in discriminating between the good, the mediocre, and the bad.

18.

It seems to me the fairest method is that a certain minimum salary should be attached to each title and that the appointment to such a place would necessarily carry with it this minimum salary, but there should be possibilities of individual increase over this minimum. The factors which should determine this differential are various. The success of the professor in his particular field, either as a teacher or as an investigator, or as a leader of public thought, or interest in university activities should be followed by some recognition in the way of increased salary. I am afraid that, if promotion were simply a matter of time or routine, there would be a distinct lowering of effectual effort for ad-

vance. The more highly one prizes an academic grade, the greater should be the possibilities of this differentiation.

While academic life is not strictly comparative with business life, they should have certain analogous elements. It is easy to get one-thousand-dollar men in business, much more difficult to get five-thousand-dollar men, and almost impossible to get ten-thousand-dollar men, but a ten-thousand-dollar man is worthy of his hire. So in the university, the ten-thousand-dollar man should have his corresponding reward. Of course, the elements which make for success in an academic career are not the same as in a business career. The standards are different, the aim is different, but what I want to bring out is that the value of men is so different that they can not be fairly classified by the ordinary academic grades, and, while in the university the money reward is not the sole object of the professor's work, it should form a certain element of it.

19.

In my opinion professorships within the same university should unquestionably be placed upon a like financial basis.

I find the most emphatic argument for this in the evils that almost inevitably accompany any other disposition. Those evils, indeed, seem to me a most serious menace to the amelioration—so much needed—of the professor's standing. In the absence of such a system or practise, the individual professor is likely to spend serious efforts in enforcing his claims to securing such advances in salary as he can effect. Most directly and most frequently he encourages offers of affiliation with other institutions. He particularly suggests, when such inquiries come, the necessity of additional financial inducements to secure his transfer; at other times the university aspiring to secure his services at once holds out the lure of additional income. If he accepts such an offer, he is likely to find in the new environment that he has been engaged at a salary denied to many of his colleagues of longer service, of greater adaptation to the needs of that institution, of equal reputation and attainments. Such a position should be more generally embarrassing than it seems to be. If he declines the overture, he is likely to yield to the temptation to demand of his present authorities that they compensate him for the loss he has incurred by declining the 'call.' The commercial standards that thus enter degrade the proper appreciation of academic standards and prevent the emphasis upon the essential factors of academic compensation. There are to-day many men of first-rate character and value receiving most inadequate salaries, while in the same faculty are a few men with far better incomes whose greater freedom from care is due merely to the fact that they entered the institution at a later period of its history and have not to their credit years of self-sacrificing service. Such a university actually punishes those who have aided to build it up. It may be replied that this difficulty could be avoided by increasing salaries from within as generally as from without. I reply that the spirit of this method is against such procedure; and that a complete adjustment would amount to nothing less than an equality of salary.

I shall say little of the feeling of personal injustice, of jealousies small and great, proper and improper, that arise under the system that allows each man to fight for himself alone. I mention the fact that, struggle against it as we will, men will be rated by the salaries they receive. Academic democracy is hampered in its expression, and men are judged by false standards. It is but an exaggerated expression of this attitude—something that hangs in the air and contaminates—that induced more than one graduate student in a certain but nameless institution to look up in the proper report the salaries of the several professors under whom study was contemplated, and to choose those with the largest figures to their credit. They wanted their 'majors' only under at least '$3,000' men. This is the rating that figures in the Sunday issues of our great and representative dailies.

The fact that the only practicable mode of avoiding the inevitable difficulties, injustices, inequalities, and pernicious influences of a system that leads each man to struggle for himself, is to adopt the system of equality: this alone seems to me an adequate reason for the system I advocate. Yet it seems to me that equally with the avoidance of evils is there in the 'equality' system the greatest good, alike in principle and in practise. The very freedom from care and unrest and uncertainty, and the consequent emphasis placed upon the incumbent's devoting himself to his proper interests, is a great step in itself. Nor can I see why any president or board should desire to complicate matters by attempting to differentiate among equally, or nearly equally, worthy men by a financial standard. It is sometimes said that the business of a president or of a board is to translate academic utility into money values, a task for which a composite of

Solomon, Job and Socrates would be inadequate. The thing is an obvious impossibility, and, as said before, a crude attempt to force the distinction places a most undesirable emphasis upon a distinction that fundamentally has no place in the academic life. The very fact that a president is willing to prove to his board that Professor A. is worth $2,600 to the university, while Professor B. is worth $2,700, seems to suggest rather forcibly that the result might better be left to the throw of a die.

We must also remember that under present circumstances these discriminations may mean all the vital difference between finding a debit or a credit in the year's accounting. If professors were paid upon an adequate basis, the problem would shift in importance, though the relative value of principle would be the same. A salary should secure a reasonable, comfortable living. The salary is intended to permit one to live and pay one's bills; those bills are largely determined by the standard of living. The butcher and the baker—unlike the graduate student—do not consult the salary list before making out their bills. These come in to the fortunate and the unfortunate alike.

Nor can I see any useful purpose that a differentiation of salary serves. I have never heard any defence thereof that at all aims to set forth its utility. It is generally set forth as a practical necessity. A certain man can be had only by offering him a certain salary. Trustees are influenced by these superficially business-like considerations; and so the specious argument with its attendant evils returns and grows in force. Yet in the long run, the university that strains its maximum efforts to pay adequate salaries will reap the benefits of its worthier policy. Indeed that is the case to-day. To anticipate the occasion of a summons elsewhere, to place the emphasis upon academic privileges, to make it clear that the best the university can do is already done, and is not withheld until a 'hold-up' forces the situation, is more likely to attract and retain the proper kind of man than any shrewd juggling with the translation of academic deserts into dollars and cents.

I do not address myself to the practical problem—related yet different—of providing a system for the proper advancement of men from subordinate to the higher positions. I believe the issue in such cases is properly that of determining by academic standards when and whether the candidate is to be advanced to a higher rank. Some should be advanced more rapidly than others. Such differentiation is part of the selection that is as necessary in the academic as in any other career. But once selected, the further differentiation of salary should be affected by no other consideration than time of service, and such other regularly provided conditions as belong to every man's career.

20.

As an ideal, the payment of uniform salaries to all who may bear the same title would seem highly desirable, inasmuch as it would in effect recognize the equal value or importance of one department with another.

As a matter of practical university administration, it will always be difficult to realize any such ideal, and chiefly for these reasons:

1. While all professors should be equally eminent in their respective professions, such will not be the case in any actual faculty. Certain individuals may tend to stagnate, others to draw forward and in various ways differences are sure to exist.

2. As a result of these differences, either in professional or in collateral qualifications, it will result that in a real sense, certain individuals may become of more value than others, no matter on what basis 'value' may be estimated. Such differences may not improperly be made the basis of a difference in salary.

3. Due to one cause or another, the services of different members of the same grade of the teaching staff may have different market values. Certain individuals may be more or less prominently before the public, or may receive calls from other institutions, and if it is desired to retain their services, an advance in salary must be made.

* * *

To summarize: if universities could be provided with ideal faculties and administered under ideal conditions, doubtless equality of salary in the same grade should and would prevail. Under actual conditions and as a practical administrative problem it does not seem likely that it ever will.

21.

I am strongly inclined to think that men bearing the same title in a given institution should receive the same salary, or what would be better, if practicable, that there should be a fixed scale of advancement by years so that new appointees could start in at the bottom of the scale and receive a regular increase of salary until a certain maximum is reached. It might be necessary to recognize services in other institutions at similar grade in adjusting the pay of men changing

from one full professorship to another. To give satisfaction such a sliding scale would have to be administered uniformly and the practise of withholding the expected advance in some cases and in making it in others strictly debarred, otherwise members of a faculty would feel themselves perpetually under trial and while this might stimulate a certain feverish activity, it would not promote the efficiency of the body as a whole. I believe that the healthiest system and the one which would lead to the finest *esprit de corps* to be that of uniformity of pay; the salary in the case of each institution to be of public knowledge. A sliding scale of annual increase which could be relied upon would be satisfactory to the younger members of the staff and peculiarly advantageous to those who remain in service for a long period of years.

Such a system would do away altogether with the present very objectionable practise of trying to obtain offers from other institutions, not for the purpose of accepting the same, but to force an increase of salary in the position which one already holds. At present this is in many institutions the only successful way of improving one's condition as regards pay.

Such a system as that outlined, however, should be so arranged as not to altogether discourage migration; for, aside from mere monetary considerations, it is doubtless better for the universities and their professors to have a certain reasonable amount of change of personnel, on the one hand, and of environment, on the other.

It might possibly be found necessary to pay higher salaries in departments which come into touch with practical life, such as the chairs in engineering, architecture, medicine and law, than in the case of purely academic positions, because of the demand outside of the universities for men fitted to fill these positions, but such a distinction is unfortunate and should be avoided if possible. If a man conversant with practical affairs selects a university career he does so necessarily at a pecuniary sacrifice and it is perhaps not too much to ask him to be content with the same pay as his colleagues in other departments.

22.

As regards instructors in different schools, or perhaps even in different departments of the same school, some variation seems necessary. Experts in law, medicine or engineering, even though of no greater relative prominence in their specialties than teachers in the so-called academic departments of the university, must ordinarily be paid higher salaries than other teachers, simply because a sufficient number of first-class men can not be gotten away from the competition of active practice in these subjects for salaries that will procure good teachers in the academic departments; otherwise, indeed, a university proposes to pay the academic teachers on the basis necessary for the professional ones, which is not likely to be the case. I assume, therefore, that the practical question for discussion is whether there should be variations in the salaries paid to men of the same rank in the same school or similar departments. Ordinarily, I should think it preferable to pay the same salary to men bearing the same title and doing work similar in amount and general character. Where a university's funds are reasonably adequate to the work it is attempting to do, this seems the best way of preventing jealousies and dissatisfactions which are very natural where there are marked distinctions in salary among men of the same rank. At least this is true among professors and associate professors, though the reasons for it are not nearly so strong in the case of temporary appointees like instructors and assistant professors. A variation of salary within certain limits may here often be proper and useful in enabling the university to retain a good man whom it can not immediately promote to the higher ranks. In any case, however, I should think it proper for a university in rare instances to pay special salaries to men of extraordinary abilities. The salary of a professor is not large at best, and a university teacher with an opportunity to earn a much larger sum outside of the university might occasionally have duties that he felt obliged to discharge which necessitated a larger income. If his value to the university were very great, I should think it proper for the university to retain him by special arrangement, but such cases would be very few in number.

Institutions whose income does not enable them to employ the usual number of full professors at salaries paid for good men by the larger universities must necessarily choose between having all the men in a department below the first rank, or trying to have at least one first-rate man in each department who shall be paid a substantially higher salary than the others. I should think it better for an institution to pursue the latter policy; but it would be difficult for such an institution to retain its better men, even of the second grade, if it never advanced any of them to the rank of professor except the heads of departments. The title of professor is looked upon

by a considerable number of excellent men as a substantial promotion even though unaccompanied by much increase in salary; and I should think it proper for a university with a moderate income to act upon this known fact of human nature. I am pretty sure it would be able to retain better teachers, in the long run, this way, and that is the principal object to be gained by salary rules. Perhaps even such a variation as that just suggested could be made the subject of regulation by constituting heads of departments a higher class than full professors.

23.

As there are many different degrees of worth, or value to the university, among the men of its faculty, and as but a limited number of these degrees is represented in the usual scale of titles composing the faculty organization, I should say, decidedly, that the same salary should not necessarily be paid to men bearing the same title. The differences in salary should correspond as nearly as possible and expedient to the differences in degree of worth of the men to the university. The factors determining this worth are several and various. Some of them appeal primarily to our ideal professional qualifications; others appeal more to our recognition of the practical necessities of university administration. Theoretically, the ideal qualifications should be the preferred and most rewarded ones: actually both categories of qualifications must be taken into account. But there is no scale of degrees of worth determined either on the basis of ideal qualifications alone, practical necessities alone or (as is inevitably the real basis) of a combination of these two, that does not include in its series more degrees of gradations of importance than are represented by the conventional scale of faculty titles or positions. These degrees should be recognized and rewarded by differences in salary, even though they can not be by differences in title.

24.

I believe there should be a minimum standard of salary for a given title, but that the maximum should be varied to suit the class of men engaged in such work. *Many valuable men deserve an advance in salary before they deserve promotion in rank;* in fact, some exceedingly helpful men may never deserve a high rank as to title, but become increasingly useful as members of the teaching faculty. It is my feeling that a professorship should not be awarded simply and solely because of scholarly attainments or ability as an investigator; the title has a greater content than these qualifications imply.

Under the present economic condition the salaries now being offered to college workers are so meager as to offer no incentive to young men of ability to enter the profession. Of course, many young men of ability are entering it, but they are doing so with no hope of any financial reward and many of them are not conscious of the difficulties that await them. It is easy to say that the best men are willing to make sacrifices, but it is not so easy to see that the sacrifices which they are called upon to make are many times serious detriments to their advancement. For example, comparatively few men in college work, relying wholly on their salaries, can afford to hire a stenographer or reader to do certain amounts of detailed and more or less mechanical work. This is not as it should be. Much more time could be given to investigation, and they would have more desire to investigate and devote their energies to essentials, if they could be relieved of the purely mechanical work. At present, as I say, relying wholly upon their salaries for support, this is practically impossible.

In conclusion: people of the country are, in general, of the opinion that college professors are poorly paid, hence there would be no serious objection on the part of the public to a change for the better.

25.

The titles do not represent ranks of men in military alignment, but a group of runners spaced out yonder on the track. Our hope is to space them out more widely still by evoking from each best one his utmost effort and speed. A prize—of some sort—is what human nature demands in all such cases. 'To him that hath shall be given' is never truer nor more just than here. Now the title itself is a prize. But the title of itself affords no further inducement to him who has already won it; and for those of the highest academic rank no further prize of that sort is possible. But this last is precisely the group that most needs such stimulus.

To rely upon the desire of fame alone to furnish the needed spur seems to me not quite all we may rightly do. Fame depends upon too many accidents, and generally comes too late to avail the individual for further effort. It seems, moreover, not quite fair that the world generally should be left to pay the debts of the university for exceptional service rendered first of all to the university itself. The evils which are feared in this connection—bitterness, jealousy and the

charge of favoritism—are already here, and will inevitably attend any attempt to recognize excellence. The way to deal with them is neither to efface distinctions already established, nor to refuse to carry them further as may be needed; but rather to make sure that every such recognition of excellence shall carry with it the conviction of its essential justice and desert. I see, therefore, no reason why the principle of special reward for special service, operative everywhere else, should be made inoperative within the charmed field of a certain academic rank. To make it so suggests at once the methods of the 'union,' and its results—loss of incentive towards excellence because mediocrity will answer just as well!

And I make no question of recognition of a pecuniary sort. Added pecuniary resource here is not so much *pay* as it is a necessary condition of further and continued effort; relieving the scholar's mind from carking cares, and his body from profitless fatigue, and setting free his energy to do its proper work. Nor should it be necessary for a man of proved value and ability to work for a position elsewhere, in order to come into the enjoyment of what he has deserved at home.

A graded use of salary during the two or three years of one's novitiate in the professorship—if the man has it in him to rise at all—seems almost the only proper thing—and works well in practise. The associate professorship seems not so distinctly to need an augmentation, since it should lead betimes to the next stage. But in the last stage the principle of recognition of exceptional quality, I think, should have large sway.

26.

In order to answer your question, two things must first be clear, viz.: (1) The basis on which salaries are fixed; (2) what is implied by the same title?

As to the first I may express the fairly obvious belief that salaries should be the pecuniary compensation for services rendered. In practise, however, the salary question is frequently complicated by the introduction of other matter. In fixing salaries the only condition should be 'value received.'

Assuming this, if the same title truly indicates equal usefulness among the men who hold it, I believe that equal salary, equal compensation, is both logical and just. But unless men equal in rank are also equal in usefulness, I do not see that equal compensation is justified.

I may therefore state my opinion regarding your question in these terms:

1st. Salaries should be compensation for services rendered;

2d. They should be fixed only according to services rendered;

3d. The salary of an individual should therefore be determined solely by his usefulness;

4th. Unequal usefulness of men in the same or in any rank should necessarily imply unequal salary.

27.

Equality of salaries would presuppose at least approximate equality in scholarship; but there are very few universities in this country that have reached that stage. In other cases a uniform salary scale would seriously hamper the appointing power in its efforts to secure good men, especially in universities that are at a disadvantage in consequence of their geographical location or for any other reason; unless indeed the salaries be placed at the maximum figure obtaining anywhere, and that is obviously impracticable.

28.

In general, I think that it is not just to pay the same salary to all bearing the same title. It seems to me that there are at least four reasonable grounds for such discrimination:

1. Relative success in teaching;

2. Relative success in research or in otherwise contributing to knowledge;

3. Various personal qualities not easily defined, but going to make up character and culture, and manifested in the teacher's influence for good on the student;

4. Length of experience. If the teacher does not grow, he should not remain in the university. If he does develop from year to year in such qualities as those referred to above, it is right that he should receive better pay.

I most emphatically do *not* believe in salary discrimination based on a 'commercial' valuation obtained from the demand for the teacher by other institutions—a condition which already exists to too large an extent. When the laws of supply and demand govern the salaries paid our teachers the influence of our universities for good must certainly suffer. We should see such results within the faculties as now exist on the campus—an able teacher of Latin, let us say, of high character and long training, and successful as a teacher, getting perhaps $1,000 or $1,200, while a recent graduate, of doubtful character,

can command $5,000 for six weeks' work as football coach.

29.

I am distinctly of the opinion that we are too careful in differentiating officers of the university according to age and title rather than to ability, activity and general usefulness.

Universities are lax in encouraging young men to leave the university when they are not fitted, and at the same time American universities seem to be equally lax and short-sighted in disposing of older men who in their prime were a great help and honor to the university. The modern trust is much more humane in these matters and, it seems to me, takes better care of its good men.

Salaries should not be paid in amounts proportionate to arbitrary gradations of title. When a man has proved his usefulness to the university, the university should be willing to pay him any reasonable salary to retain his services.

30.

A member of a university faculty is likely to put more life into his work, if from time to time he should receive some definite recognition of excellence to which he may attain, whether in teaching, research, executive work, or length of honorable and efficient service. This recognition may come to him in a variety of ways, one of which is increased remuneration. It is desirable that such encouragement should be given him more often than he could be promoted from title to title, for a complex system of titles would be unwieldy. Therefore, a minimum and maximum salary should be established for each title, a man being advanced, now within his title, now from one title to another, as he shall merit.

In reading this President Jordan made the following comment:

I may add a word of my own to Professor Stillman's discussion of this topic.

The problem is rendered more complex through the existence of the assistant professor, on whom in great part the work of the American college now falls. Historically, the assistant professor is a recent development and his position has no analogue in the universities of England or Germany.

The fact that the American universities are teaching institutions, as distinguished from those whose primary function is that of an examining board, has had a large influence in shaping our university organization.

In England and Germany, in general, there is an established standard of excellence of erudition or of culture to which the student aspires. In framing this standard, no consideration is paid to the powers or the tastes of the individual standard. It is a standard set by society or by academic tradition, and only in late years has the number of such ideals or goals of effort been multiplied.

In Europe generally, the professor teaches what he pleases, but the student uses what he teaches only as an aid to a predetermined end. The teachers of minor grade find their opportunity when the professor fails to make his work useful as a preparation for examinations. If a Privatdocent can make his work attractive and practical, the students will pay for it. Otherwise he may starve. The university has no responsibility for him, no interest in his fate. Neither does the university feel any obligation that the subjects demanded in examination shall be well taught to each individual candidate.

This is especially true of the older universities of England, and to this day the chief university function which is unquestioned is that of examining for degrees. One and all, they are primarily examining and not teaching universities.

In an examining institution, fees are charged. These fees mostly go to the professor, and very unequally, but that is his own concern. If he is interested in them, he should choose a remunerative field. The professor needs only assistants of an inferior order. These he may pay himself, and their status does not concern the university. If professor and assistants fail to cover the ground, the private tutor covers the rest, and for him again the university has no responsibility.

In a teaching university, every student must be reached. The classes taught must fairly represent the subject and the numbers in each class must not be greater than the teachers can properly handle.

In the small college under the old régime, this work was divided among a group of professors. The elective system demands many more teachers and better ones, so far as class-room work is concerned, than the English system. It is, in fact, the element of choice, whether between fixed courses, or between courses, which is responsible for the great extension of the American college system, which is now at its height.

Needing many more teachers, without the means of making them all professors, and with the opportunity of trying them out before promotion, has called into being the great army of assistant professors and others of intermediate grade, who do most of the actual work with students in the American colleges and universities to-day.

It is manifest that no system of automatic promotion by which each of these can ever be assured of a professorship in his own institution, is possible. There will never be professorships enough to go around, and even the best men must often look for promotion elsewhere. Besides this, only a small percentage of these men show that combination of personality, character, scholarship, productiveness and force which should make them worthy of first-class professorships anywhere. In the promotion of these men, the interests of the university or college as a teaching body, in other words, the interests of the students, constitute almost the sole consideration.

It is a matter of wise administration to allow a reasonable minimum in each grade, enough to enable a man to live decently. It is well to make a small automatic addition to this from year to year. It is well that this addition should cease when further promotion is not in the university's own interest. It is almost as injurious to overpay a mediocre man as to give a good man too little. The only justification for either is found in the limitations of financial ability and in the absence of means for exact valuation of the achievements and the possibilities of the various instructors. The rapid promotion of exceptional men is, under our system, a necessity. Equal pay under equal conditions considers the position, not the man, as the unit, and it is only possible under static conditions. Applied to the American university of to-day it would leave to the institution only the dregs of the faculty, unless its equal pay was held level with the maximum in other institutions. Except in two or three of our strongest universities, that course is at present impossible.

Because the university has assumed responsibility for all the necessary teaching, and this with the exaction of low fees, and in some parts of the country none at all, the assistant professor is part of the system as much as the professor. At the same time, the assistant professorship has risen through necessity, not through the voluntary choice of university authorities. We are not certain what he ought to be paid, how rapidly he should grow, or what should be his status in academic matters. These matters are mostly determined for us by necessity. We have not yet reached agreement as to whether he should have an equal voice or any voice in academic matters. University legislation usually tends to give him a nearly equal voice, regarding the academic executive as merely first among equals. University custom tends to hold the executive responsible for his associates, after the fashion of business corporations. There is justice in both points of view, and it is well for the universities that the two tendencies should continue

to strive with each other. But the final outcome will be that the president of the university will be the executive representative or spokesman, not the ruler of the faculty, and the department head will stand in similar relations to his fellows. Meanwhile the title is an academic honor, the salary a practical means to an end, and so long as our universities are in process of formation, the two will not bear any automatic or static relation to each other.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

MEETING OF SECTION G (BOTANY)

SECTION G held three independent sessions for reading of papers, December 28 and 31, 1906, in the rooms of the botanical department, Schermerhorn Hall, Columbia University. The attendance ranged from about thirty at the last session, when the Botanical Society was holding a simultaneous meeting, to about one hundred and twenty-five. On December 28 a joint session with Section F (Zoology) was held at Teachers College, at which over three hundred persons were present. Owing to the absence, on account of illness, of the retiring vice-president, Dr. Erwin F. Smith, the hour assigned for his address was used for other papers.

During the past year there has been effected a union of three affiliated societies, viz., the Botanical Society of America, the American Mycological Society and the Society for Plant Morphology and Physiology, the combination bearing the name of the oldest and first mentioned of the three. This has simplified somewhat the relations of other botanical interests with Section G. The new Botanical Society held two sessions in which members of the section were largely present, the attendance then being over one hundred; one of these sessions was held at the New York Botanical Garden, Bronx Park, after which all the visiting botanists were entertained at luncheon by the garden. The society held two sessions on December 31, simultaneously with Section G.

Forty titles were submitted for the program of Section G, from which about thirty papers were actually presented. The first six of the following were read before the joint session with Section F.

Elementary Species and Hybrids of Bursa: GEORGE H. SHULL, Station for Experimental Evolution, Cold Spring Harbor, New York. (To be published in SCIENCE.)

Mendel's Law as a Tracer of Lost Parents —I. The American Carnation: J. B. NORTON, U. S. Department of Agriculture.

In this paper it will be shown that the common greenhouse carnation is a hybrid type whose two parents are a single form and a very double form. These parental types have been extracted by ordinary breeding methods and recombined to produce a uniform hybrid first generation agreeing with the standard commercial types. This is the first experiment, so far as the author knows, that shows a commercial application of Mendel's law of heredity.

Preliminary Note on Pollen Development in Œnothera lata De Vries and its Hybrids: R. R. GATES, University of Chicago.

Œnothera lata is one of the mutants which does not mature its pollen, and hence must be pollinated from another species, producing a hybrid in the next generation. The plants studied were from a cross between *O. lata* and *O. Lamarckiana,* which is a Mendelian hybrid, showing in the next generation, according to De Vries, an aver-

age of 15 per cent. *O. lata* plants, the remainder being *O. Lamarckiana,* the pollen parent.

It is found that pollen development in *O. lata* may proceed to the formation of tetrads. The later stages are very irregular and result in complete degeneration of the pollen cells, usually long before maturity. This degeneration may begin in some cases as early as the synapsis stage. Irregularities in the distribution of the chromosomes in the reduction divisions give rise to small extra nuclei in the pollen tetrads, and other conditions similar to those found by Juel in *Hemerocallis fulva* and *Syringa Rothonagensis* (a hybrid), by Tischler in hybrids of *Ribes,* by Guyer in hybrid pigeons, and others. The prevalence of the condition, especially among sterile hybrids, suggests that it may prove to be a distinguishing characteristic of certain classes of hybrids.

The sporophyte number of chromosomes in *O. lata,* as determined in the prophase of the heterotypic mitosis in the pollen mother cell, is 14; while the sporophyte count for the *O. Lamarckiana* side of the cross is at least 20. The conclusion from this is that the pure *O. Lamarckiana* itself must have over 20 chromosomes. It is believed that differences among the chromosomes of *O. Lamarckiana* and its mutants may furnish a cytological basis for discontinuous variation, and hence a count of the chromosomes in *O. Lamarckiana* and other mutants is to be made at once to settle this important point.

In both sides of this cross the heterotypic mitosis in the pollen mother cell shows one, or more commonly two, ring-shaped chromosomes with a peculiar history. They may be designated heterochromosomes. In *O. lata* their origin has been traced. They arise during synapsis, apparently by the cutting off of a loop of the spireme, for in earlier stages of synapsis the whole spireme is continuous. One or two of these bodies may be formed as large rings or closed loops some time before the rest of the spireme breaks into chromosomes. Later they are found, much condensed in size, on the spindle; but in metaphase they have generally wandered towards the poles or out into the cytoplasm, where they probably disintegrate. Their possible significance in connection with the phenomena of mutation will not be discussed now. The full paper will appear shortly.

On the Behavior of the Seedlings of Certain Hybrids of Viola: Ezra Brainerd, Middlebury College, Vermont.

Many violet hybrids are found in the second generation to revert in some characters to one of the parent species, and in other characters to the other parent species. Illustrations are given of this in four particulars: (1) in leaf-outline; (2) in pubescence; (3) in size; (4) in color of capsule and of seeds.

The tendency of certain individuals to recover from impairment of fertility is shown.

Illustrations are given of the way in which species may arise by the attainment in the more marked hybrid forms of fertility and stability in reproduction.

Origination of Species by Hybrids among Wild Plants: D. T. MacDougal, Carnegie Institution. (To be published in the *Botanical Gazette.*)

An Instance of Natural Hybridization: W. W. Rowlee, Cornell University.

In 1896, the writer in conjunction with Dr. Wiegand, published an article in the *Bulletin of the Torrey Botanical Club,* describing as hybrids certain willows that grow in a small peat bog near Ithaca.

The writer was impressed at the time

(and the impression has grown since) with the insecurity of diagnoses of wild hybrids. Inferential evidence must be accepted that the plant is a hybrid in the first place and in the second place the parentage must to a considerable extent be assumed.

The case which came under our observation was perhaps clearer than some others because one of the supposed parents, *Salix candida,* was confined to this particular locality. No other station is known for the plant within a radius of forty miles. The other parent might have been any one of several willows growing near by. The morphological characters of the hybrid pointed strongly toward *S. cordata* as the other parent, and it was so decided in the published paper.

After the publication we undertook to hybridize artificially *S. cordata* and *S. candida,* with the result that duplicates of our wild hybrids were produced. It became at once interesting to inquire into the conditions under which the wild hybrids were produced. As stated above, one of the parents was local. The area covered by the bog is less than an acre. It is completely surrounded with hard ground that was covered in its primeval condition with a heavy growth of trees. After the country was cleared up the owner of this swamp (before 1870) made an attempt to convert it into agricultural land by drainage and tillage, and succeeded to the extent of lowering the water level so that he could clean the surface and in a dry season plow it. The ground proved to be full of copious springs, and in spite of the complete system of ditching, it remained too wet to be manageable. During the period of cultivation *Salix candida* was nearly exterminated. It, however, maintained itself sparsely along the ditches. When the farmer abandoned his attempt at reclamation *Salix cordata,* which grew in abundance in the vicinity, invaded the swamp. A fertile and unoccupied seed-bed was afforded, and plants that found it congenial took possession. Of the shrubs, *Salix candida* and its hybrids apparently succeeded best, and the result is a plantation of very interesting willows, a complete series of which have been taken. It seems highly improbable that these forms appeared in the swamp prior to 1880, as Professor Dudley and other students had studied the flora of this particular place carefully and repeatedly.

The conditions existing in this peat bog have suggested to the writer that the clearing of the country may have given similar opportunities to other species. The numerous forms of *Cratægus* and other types recently described, readily adapting themselves to open conditions, may have had their rise under conditions similar to those in which our hybrids of *Salix candida* developed.

A Natural System of the Discomycetes: F. E. CLEMENTS, University of Nebraska.

Spore Forms of Spegazzinia ornata Saccardo: ERNST A. BESSEY, Subtropical Laboratory, Miami, Florida.

Two spore forms are known for this fungus, one long-stalked with spiny processes and one short-stalked and smooth. According to Saccardo the latter are borne on the spines of the former. Cultures have demonstrated that the forms are independent of one another and arise directly from the fungus mycelium.

Accelerated Blossoming due to Defoliation by Storm: ERNST A. BESSEY.

On October 18, Miami, Florida, was visited by a hurricane of great intensity, lasting about nine hours. The wind attained a velocity of probably seventy-five to eighty miles an hour and possibly still higher for certain gusts. To a considerable extent both native and exotic trees

were defoliated, the loss of leaves varying from that of those at the extremities of the branches to the total defoliation of the tree, often accompanied by loss of branches. Among the trees thus affected were live-oak (*Quercus virginiana*) and mulberry (*Morus rubra*). The former does not shed its leaves normally until the new foliage is fully developed in the spring, thus being evergreen, but the latter is normally without leaves in December and January.

About three to four weeks after the storm, defoliated trees of both species pushed out into flower, new foliage buds beginning to unfold also. The normal time of blossoming is about February 1, so that the time of blossoming was accelerated eight to ten weeks.

It is interesting in this connection to recall the newspaper reports of the Mobile hurricane according to which peaches and other fruit-trees came out into bloom two or three weeks after that storm.

This phenomenon of blooming being hastened by defoliation is not rare. In Paris, in August, 1904, the writer saw horse-chestnut trees that had been defoliated by some insect, pushing out into bloom again. It is by no means unknown in America. Following the freeze at Miami, at Christmas, a pomelo tree was observed which had lost the leaves on one of its large lower branches. This branch was in full flower three weeks after the freeze.

The explanation of the appearance of the blossoms when the trees start to reform their leaves lies in the fact that the flower-anlagen are laid down in the summer so that when the leaves expand the flowers also appear. The fact that the root and trunk cells had not reached the dormant condition is probably the explanation for the fact that the trees defoliated in October produced new leaves and flowers so soon. Possibly if the weather had remained cold for several weeks after the storm the plants might have assumed their winter dormancy.

An Outbreak of the European Currant Rust, Cronartium ribicola Dietr.: F. C. Stewart, Geneva, New York.

Cronartium ribicola is an hetercecious rust having its uredo and teleuto stages on the leaves of various species of *Ribes* and *its æcidium stage* (=*Peridermium strobi* Kleb.) on *Pinus* spp., particularly *P. strobus*. In Europe, where it has been known for fifty years, it is widely distributed and in some regions causes serious injury to *Pinus strobus*. With one possible exception, it has never been collected in America prior to 1906. Accordingly, it is interesting to note that in September, 1906, the writer found it abundant in a currant plantation on the grounds of the New York Agricultural Experiment Station at Geneva, N. Y. In this plantation three species (*Ribes nigrum, R. rubrum* and *R. aureum*) were represented by fifty-four varieties, forty-eight of which were affected. In many cases every leaf on the bush was affected. *R. nigrum* suffered most and *R. aureum* least. Near-by specimens of *R. grossularia,* also, were slightly attacked. The source of infection is unknown. The only specimens of *Pinus strobus* nearby are two apparently healthy trees planted eight years ago 112 meters west of the infested currant plantation. All *Ribes* plants on the station grounds have been destroyed in an attempt to stamp out the disease.

The Origin of the Hymenium in Some Geoglossaceæ: E. J. Durand, Cornell University.

The hymenium of the Geoglossaceæ has been supposed to be free or exposed from the first. Schroeter made this character the distinguishing character of the Helvellineæ. Dietrich called attention to the fact that in *Leotia lubrica* and *Mitrula phal-*

loides the hymenium was at first covered by a delicate membrane or veil, which it breaks through. The writer's observations on several species confirm those of Dietrich. It is probable that in all members of the group the hymenium is at first covered.

Notes on the Embryology of Rhizophora Mangle: MEL. T. COOK, Santiago de las Vegas, Cuba.

Presents many difficulties in technique, owing to the presence of tannin, etc. Only one of the four ovules develops. Integuments develop early and increase the difficulties. Embryo-sac apparently follows the normal course. Embryo has a long filamentous suspensor, the synergid end of which degenerates very early, but the opposite end persists very late. Endosperm very abundant and the outer cells grade almost imperceptibly into the nucellus cells. The cotyledons develop very early at the expense of the endosperm cells and have the appearance of being very much cramped. After the development of the cotyledons is well advanced the root tip begins to grow more rapidly. At the same time the surface cells of the cotyledons become very much modified and very protoplasmic, evidently for absorption. Cells through the entire embryo show evidence of great activity, the vascular system becomes more prominent and peculiar ingrowths from the surface of the cotyledons connect with it. Endosperm almost entirely disappears and the embryo is fed by the mother plant.

The Embryology of Rhytidophyllum Crenulatum and R. Tomentosum: MEL. T. COOK.

Of interest because the family is tropical and subtropical and unworked morphologically. Ovule anatropous. Archesporium a single subepidermal cell which usually does not divide but elongates and produces the normal eight-nucleate sac. Synergids small and staining deeply. Antipodals small and disintegrating early. The polar nuclei unite near the antipodals. Micropyle and pollen tube conspicuous. Entrance of pollen tube obliterates the synergids. Endosperm undergoes primary division before the first division of the proembryo, and the two daughter nuclei are separated by a cross wall which soon disappears. Both nuclei divide rapidly. Micropylar endosperm disintegrates very early. Embryo at first filamentous, followed by a division of the apical cell. Suspensor elongates and appears to function as a haustorium, then disintegrates. Differentiation of tissues does not follow the exact order of *Capsella bursa-pastoris* and other dicotyledonous plants.

Radioactivity a Factor in Plant Environment: C. STUART GAGER, New York Botanical Garden.

The hitherto recognized factors of plant environment may be classified as molar (including living organisms), molecular and undulatory. Radioactivity is an expression of atomic disintegration, and is accompanied by a relatively enormous release of energy. At least four different factors may be included under the term radioactivity, for the breaking down of the atom of a radioactive substance is accompanied by (1) a stream of negatively charged ions or 'corpuscles,' each about one thousandth the size of a hydrogen atom, and moving with about 95 per cent. the velocity of light. Streams of corpuscles constitute the *alpha* rays; (2) a stream of positively charged ions, of nearly twice the size of a hydrogen atom, and moving more slowly than the corpuscles. Streams of positive ions constitute the *beta* rays; (3) an electro-magnetic pulse, analogous to the X-ray, and caused by the starting or stopping of ions. These rays, given off from radioactive substances, are termed *gamma* rays; (4) the

emanation, an inert gas of the argon family, which is radioactive, and whose atoms are, therefore, undergoing a disintegration.

Recent researches lead to the conclusion that the phenomenon of radioactivity is not confined to the so-called radioactive elements, radium, uranium, thorium and others, but is a general property of matter. Not only are the heavier metals, such as lead, zinc, silver, but various other substances, namely aluminum, copper, tin-foil, air from soil, spray at the foot of waterfalls, mud, tap water, petroleum, freshly fallen rain and snow, metal surfaces on which light waves of short wave length impinge, and flames, have all been found to give off a penetrating radiation. It seems probable that radioactivity is a general property of matter. Results already obtained demonstrate conclusively that it is a factor in the normal environment of living things, and its effect on the life processes of plants becomes, therefore, a matter of considerable interest and importance.

Some Effects of Radioactivity on Plants: C. Stuart Gager, New York Botanical Garden.

In ascertaining the effects of radioactivity on plants, it has not been possible satisfactorily to screen out the various kinds of rays, and the emanation, so as to study separately the effects peculiar to each. The results obtained, therefore, must be attributed, almost without exception, to the sum total of all three kinds of rays involved in the radioactivity of radioactive substances. The present paper concerns chiefly the results obtained with radium bromide, of various strengths of radioactivity, used either in sealed glass tubes or in the form of Lieber's radium coating on rods and cylinders.

Experiments lead to the conclusion that the rays of radium act as a stimulus to the physiological processes of plants, accelerating, retarding, or inhibiting, either germination, growth, respiration, fermentation, cell division, starch formation, sensitiveness to gravity, according to the strength of the radium salt employed, the duration and distance of exposure, the intervention of screens, the nature of the tissue and, possibly, the species of the plant.

When the pollen or the ovary is exposed before pollination, or the ovary after fertilization, the resulting seeds produce plants profoundly different in the first generation from that normal for the species. If these modifications shall prove heritable in subsequent generations the ability of radium rays to induce mutative changes will have been demonstrated.

While there is seemingly a very crude analogy between radioactivity (atomic disintegration) and the molecular disintegration involved in destructive metabolism, there is nothing in the former that may be rightly compared, in any way, to constructive metabolic processes. The results of continuous experiments, covering a period of over two years, do not give the slightest support to any theory that radioactivity is, in any real sense, comparable to metabolism, or that the rays of radioactive substances are capable, independently, of elevating inorganic compounds into the condition of living organisms.

The Pathology of the Rice Plant: Haven Metcalf, U. S. Department of Agriculture.

The literature on rice diseases is scanty, and mostly in the Italian, Japanese, Dutch, Russian and Portuguese languages. Fifteen diseases have been described on rice; further research may be expected to demonstrate the identity of several of these, now supposed to be distinct. Eight rice diseases occur in America, of which six were described by the writer in Bulletin 121 of the South Carolina Experiment Sta-

tion. Of these, *blast*, the most serious, is caused by a fungus of the genus *Piricularia*, as the writer has demonstrated by repeated successful inoculations from pure cultures. It is not impossible that further researches will show this disease to be a form of the Italian *Brusone*. Two diseases are increasingly prevalent, and may have been recently introduced into the country: a 'smut,' caused by *Ustilaginoidea virens* (Che.) Tak.; and a stem rot under water, due to *Sclerotium Oryzæ* Catt.

The Production of Toxic Soil Conditions by the Roots of Plants: HOWARD S. REED, Bureau of Soils, U. S. Department of Agriculture.

The author reported the results of experiments demonstrating the excretion of deleterious substances by roots. Roots growing in non-nutrient agar rendered it unfit for further growth. The excretions from wheat were decidedly toxic to a second crop of wheat. The excretions from corn or cowpeas were scarcely, if at all, toxic to wheat. The excretions from oats were quite toxic to wheat but less toxic than those of the wheat itself. Apparently the excretions from the roots of a given plant, or of its near relatives, are more toxic to that species than the excretions from plants belonging to more distantly related species.

The Rôle of Certain Elements in the Physiology of the Plant Cell: HOWARD S. REED.

The author reported the results of experiments made at the University of Missouri. The vegetative bodies of a number of lower plants were cultivated in solutions lacking one of the essential elements. Most of the elements have more or less specific functions to perform, and, within narrow limits, there is no substitution possible. The view was held that the essential elements, in addition to building up tissues, serve as sources of energy to the cell.

Some Mutual Effects of Tree-roots and Grasses on Soils: CHAS. A. JENSEN, Bureau of Soils, U. S. Department of Agriculture.

Seedling trees of maple, dogwood, cherry, pine and tulip were planted in paraffined wire pots and the pots planted to wheat. The pots were of such size as to make a close physical relation of the roots of the two kinds of plants necessary. The pots containing the trees in every instance gave less yields of wheat than the controls, especially during summer months when the trees were physiologically active. Towards the autumn, when the trees were entering upon their seasonal rest, the wheat yields increased, sometimes slightly exceeding those of the controls. Different species of trees also had different effects on the wheat yields. As the experiment was carried on under control of external conditions, it is believed that the bad effect of the tree seedlings on the wheat growth is due to toxic substances excreted by the tree roots.

The Botanical History, Classification, and some Uses of Sorghum: CARLETON R. BALL, U. S. Department of Agriculture.

Andropogon sorghum (L.) Brot. comprises a very large number of domesticated forms. None of them is known to exist in the wild state. The cultivation of sorghum dates from remote antiquity. India and the eastern and central portions of Africa are to-day the two great sorghum centers, both in rich abundance of forms and in the economic use of them. Facts point to the independent origin of numerous cultivated forms in India and in Africa. *A. halepensis*, supposed to be the parent of all cultivated sorghums, is widely distributed over most of these two regions. Introduction into Europe took place in the

early days of the Christian era. The practise of all early botanists was to regard all forms in cultivation as distinct species. Between thirty and forty specific names have been applied to the plant and more than one hundred trinomials in recent years. Identity of the important species and the natural method of classifying and naming forms of a cultivated species. Use of sorghum for human food, forage, syrup, sugar, liquor, building material, firewood, etc.

Periodicity of the Sexual Cells of Dictyota dichotoma: W. D. Hoyt, Johns Hopkins University.

On the coasts of Wales and England *Dictyota dichotoma,* according to Mr. J. Lloyd Williams, bears its sexual cells in regular fortnightly crops. The times at which these crops are produced bear a definite relation to the tides, and the observed behavior is best explained by regarding the increased illumination obtained during the low water of spring tides as the factor which determines the time of fruiting.

Observations made at the laboratory of the Bureau of Fisheries, at Beaufort, N. C., during the past summer show that at this place also *Dictyota dichotoma* produces its sexual cells in regular crops at periods bearing a definite relation to the tides. These crops, however, are borne at monthly, instead of fortnightly, intervals, the time of their production is not influenced by differences in the height of different spring tides, and it seems that light is not the factor that determines the time of fruiting.

Evidences of Sexual Reproduction in the Slime-molds: Edgar W. Olive, University of Wisconsin. (Read by C. A. King.)

Some recent work on the exosporous myxomycete, *Ceratiomyxa,* has shown that a simple form of sexuality exists in this form. Toward the close of the more or less quiescent cleavage stage, the nuclei of the plasmodium fuse in pairs, so that the uninucleate protospores which result from cleavage each contain a large fusion nucleus. The chromatin of this large nucleus soon appears to become shrunken, or rounded up in a dense ball, at one side of the large nuclear cavity, thus resembling strikingly the condition which has been termed synapsis. That this condition is really a true synapsis, and not an artifact, is suggested by the two rapidly recurring nuclear divisions which, after a short period of rest, follow. These facts appear to indicate that a reduction phenomenon takes place at this time, similar to that which takes place in the spore mother-cells of higher plants. As a result of the double division, each mature spore of the final fructification comes to contain four nuclei.

We thus note that in the life history of this form, we have presented the three morphological stages, which, as pointed out by Blackman and others, occur in connection with the complete sexual cycle, viz., (1) *cell fusions* (when the many myxamœbæ unite to form the plasmodium); (2) *nuclear fusions* (in pairs, near the close of the development of the fructification); followed immediately by the third stage, *chromatin fusion* (associated with synapsis and the subsequent reduction division). As has been pointed out, more or less wide gaps may separate these successive stages in different plants. In *Ceratiomyxa,* we obviously have a condition comparable to that in the rusts, since cell fusion is far separated from the final nuclear and chromatin fusions.

As Blackman has further pointed out, the late nuclear fusion in the rusts has to do with the reduction phenonema which immediately follow, and he holds the opinion that the stimulus to development—fertilization proper—is imparted by the

earlier cell fusions. In *Ceratiomyxa,* the conditions appear essentially similar.

Although the numerous nuclei in the plasmodium do not apparently maintain the paired relation seen in the rusts, at least until just before spore formation, yet notwithstanding this fact, the plasmodium may be regarded as similar to the binucleate condition in the rusts, and therefore as a sporophyte stage. The 4-nucleate spores, together with the several generations of swarm-spores and myxamœbæ, would, according to this view, constitute the gametophyte development.

Localization of Plants in the Finger Lake Region and the Adjacent Ontario Lowlands of Central New York: W. W. ROWLEE, Cornell University.

The author gives a description of the physiographic features of central New York, pointing out that Onondaga, Oneida and numerous small lakes on the Ontario lowlands are strikingly different from those of the lakes of the Finger Lake Region proper.

The subject discussed in the paper deals principally with localized or rare plants in these two regions. A list of species is taken up and discussed under the three headings: (*a*) plants of recent introduction, (*b*) plants requiring peculiar conditions, (*c*) plants with no apparent cause for limited range. The paper is devoted particularly to plants of the last category, and it is pointed out that one and the same species is scarcely ever localized in both regions. Either a localized species of the uplands does not occur in the lowlands, and *vice versa;* or a species localized in the highlands will be relatively abundant in the lowlands, and *vice versa.* Again it is noted that the localized species of the highland region occur with few exceptions in wooded uplands, while those of the lowlands are confined mainly to the lakes and watercourses and their immediate vicinity.

The author concludes that in the Ontario lowland region the waterways have directly or indirectly been responsible for the introduction of the localized species, and the fact that almost all of them are at their extreme northern range indicates that they are an element of the south Atlantic coast flora at its extreme limit of endurance.

Agrostological Field Notes for 1906: A. S. HITCHCOCK, U. S. Department of Agriculture.

Outlines of two field trips: (1) Southern States, March–April, (2) Rocky Mountains, July–August. Methods of study of grasses in the field. Kind of notes necessary to take in studying the variation of a species. Results as applied especially in the genera *Panicum* and *Poa.*

By visiting type localities many doubtful species of *Panicum* of the southern states were satisfactorily worked out.

Classification of the Paniceæ: Mrs. AGNES CHASE, United States Department of Agriculture. (Read by title.)

The Sub-aerial Absorption of Water; a Function of the Ligule and Stipulaceous Tissue of the Grasses: F. L. STEWART, Murrysville, Pa.

This paper gives the results of experiments extending over a series of years; disclosing the existence of an adjustment of the external to the internal structure of the grasses whereby the moisture of the atmosphere by a system of condensation, conduction, temporary storage and absorption enters into the circulation of those plants, contributing to their nutrition and thus supplementing the supply derived from the roots.

'G' Trees: S. M. TRACY, Biloxi, Miss.

Describing a peculiar form of *Pinus Tæda L.* which occurs frequently in southern Mississippi, though very rare in other

sections. Paper accompanied by photographs.

Parasitism of Buckleya distichophylla (Nutt.) Torr: Samuel M. Bain, Univerversity of Tennessee.

This shrub, known from only a few localities in the Tennessee and North Carolina mountains, is parasitic on the roots of other trees. Like its Japanese congener, *B. Quadriala,* it has several hosts, and was found growing on *Fagus americana, Pinus virginiana* and *Tsuga canadensis,* and doubtless occurs on other species. Specimens growing on *Tsuga* appeared more robust than those growing on other hosts.

The Plant Disease Survey of the United States: W. A. Orton, Bureau of Plant Industry, U. S. Department of Agriculture.

The department has for many years collected information and statistics in regard to the distribution and prevalence of plant diseases in the United States. Beginning in 1899, an annual summary has been published in the appendix to the year book. In 1905 the scope of the survey was extended by the adoption of a plan for securing the active assistance of plant pathologists in some of the experiment stations, who were made collaborators in the department. It is expected that the work will be further extended as circumstances permit.

The object of the survey is to gather facts that will serve as a basis for the study of the science of the geographical distribution of plant diseases. It is desired, first, to learn and record the distribution of plant diseases throughout the country; second, to record the varying prevalence of these diseases from year to year, and the losses caused by them; third, to study the conditions governing the development and spread of plant diseases, including the relation of weather conditions, association of crops, the invasion of the host by its parasite and the natural resistance of varieties; fourth, to bring together a collection of specimens representing the distribution of plant diseases in the United States, which will assist in settling questions that may arise in the future respecting these matters; fifth, to summarize the additions to our knowledge of plant pathology, and the progress made in the treatment of plant diseases, and to make all this information available to workers everywhere through the files and collections open for reference in Washington, the publication of an annual summary in the year book, and through more complete reports in bulletin form to be published at intervals of a few years.

Such a project can be carried out only by a national organization like the Department of Agriculture. The underlying purpose in carrying on this work is to assist the collaborators by bringing them into closer touch with farmers and others in their states, as well as with the department, and to aid them in the investigations of their special problems.

There is a growing interest in the geographical distribution of plants and their relation to each other and to their environments; it is hoped that similar interest can be aroused in studies of the distribution of plant diseases and the important scientific and economic problems growing out of this line of work. The cooperation of many observers is required for the successful accomplishment of such a survey. It is the purpose of this paper to request the aid of all interested persons.

Fasciation in the Œnotheras: Alice Adelaide Knox, Carnegie Institution.

Fasciation in the *Œnotheras* is caused by mechanical injury due to the attacks of insects in the meristems of the growing tips. In the material studied most of the injuries came from moths, species of *Mompha,*

which live parasitically upon the primroses through part of their development. This relates both to ring-shaped and to simple fasciations.

Experiments upon the heredity of fasciation prove that in these forms the seed of normal plants produces as many flat stems as the seed of banded plants. In the *Œnotheras* the phenomena leading to fasciation are those of traumatism.

A Recording Evaporimeter: BURTON EDWARD LIVINGSTON, Desert Botanical Laboratory.

The author describes and exhibits a newly devised instrument for studying the daily march of the evaporation rate. It consists of a porous clay cup filled with distilled water and connected with a reservoir by a tube in which is placed an electric valve. A U-tube mercury contact is provided, by which an electric current flows to open the valve when a cubic centimeter of water has been evaporated from the porous cup and thus removed from the instrument. The same column of mercury makes a second contact and causes the valve to close when a cubic centimeter of water has flowed into the apparatus from the reservoir. An electric pen, drawing a continuous horizontal line upon a paper slip carried on a daily rotating drum, is raised slightly each time the valve is opened, and thus a short vertical line is drawn upon the record for each cubic centimeter of water evaporated. The spacing of these lines of course constitutes a record of the varying time intervals required to evaporate that volume. This instrument is available for recording the rate of loss of water, or of any liquid which can be used with a glass stop-cock, from any given container. For example, it can be used to produce a recording potometer for experiments upon plant transpiration.

The following papers were read by title owing to the absence of the authors when called for:

A Composite Lycopod Type from the Devonian: DAVID WHITE, U. S. Geological Survey.

This paper describes the remarkable fossil tree trunk illustrated in the New York Geological exhibit at the American Museum of Natural History. The fossil, which is extraordinary for its size and completeness, is very important systematically, since it combines certain features that serve to distinguish the later Lepidophytic groups. Most conspicuous of these are the *Sigillaria* form of leaf cushion in the lower part and the *Lepidodendron* form in the upper part. The fossil is one of the more highly developed representatives of an ancestral type *Archæosigillaria*.

Hybridization a Factor in Migration and Competition: E. N. TRANSEAU, Alma College, Michigan.

The increasing list of plants which form Mendelian hybrids by cross pollination with closely allied species and varieties necessitates the consideration of pollen dissemination in estimating the mobility of such species. The ease with which varieties of corn may be dispersed through pollination is a familiar example. Such hybrids are uniform in the first generation, but in the second (F_2) are resolved and produce some pure individuals of each parent type. A newly arisen variety of a widely dispersed species may by this means have its mobility greatly increased beyond that due to seed and vegetative propagation alone.

Competition in nature may involve several generations. In such cases factors other than the purely physical must be taken into account. The ability of a newly arisen variety to form Mendelian hybrids carries with it the chance of being carried over unfavorable seasons in the heterozy-

gote condition, which may determine the failure or success of the plant in establishing itself in a given habitat. In the case of competition between a mutant and its parent form, the chances of persistence of the former may be increased or decreased through hybridization, according as they Mendelize or produce constant hybrids.

Species which hybridize readily afford a method for the quantitative study of cross pollination.

The Morphology of Lemna trisulca: Otis W. Caldwell, State Normal School, Charleston, Ill.

The sporophyte body is regarded as composed of stem, root and leaf, not as an 'undifferentiated shoot.' Floral structures, by their relative position and age indicate that there is instead of a single flower an inflorescence consisting of one carpellate and two staminate flowers all borne on a greatly reduced spadix. Carpellate and ovular structures indicate relationship with the more complex Araceæ.

The tapetal cells may grow into the loculus, become multinucleate and almost join cells from the opposite side. Spore mother cells may act in the same way. Spore mother cells and spores may disorganize at any time.

No case of indirect division in the germination of the microspore was found, the divisions observed being amitotic.

The female gametophyte rarely matures, the ovular structures disorganizing at any time. Vegetative reproduction is depended upon almost exclusively. Seed production is seldom attempted and almost completely unsuccessful.

The Structure and Wound-Behavior of the Cedar of Lebanon: Edward C. Jeffrey, Harvard University.

The Abietineæ are divisible on anatomical and reproductive characters into two distinct subgroups, the Pineæ and the Abieteæ. The former are characterized by deciduous cones with non-deciduous scales, by the resin canals of their secondary wood, and by the peripheral resin canals of the primary xylem of the root. The latter by non-deciduous cone axes with deciduous scales, by the absence of resin canals in the secondary wood and by the median resin canal of the primary xylem of the root. The cedar is distinguished among the Abieteæ by the fact that it forms, as a result of injury, resin canals in the secondary wood both in the vertical and in the horizontal planes, which are continuous with the resin canals outside the woody cylinder. Further in the primary wood of the root, although the median single resin canal, which is characteristic for the Abieteæ, is present it is often accompanied by apparently vestigial peripheral marginal canals, similar to those found in the Pineæ. These facts together with the great geological age of *Cedrus* (older than any others of the Abieteæ) tend to show that it is the most primitive of the Abieteæ and has come from the same parental stock as the Pineæ.

Tyloses in the Tracheids of Conifers: Mintin A. Chrysler, Harvard University.

Tyloses have been regarded as normally absent in the tracheids of conifers. An examination of the heart wood of the root shows that in various species of *Pinus* true tyloses occur. These are in the form of vesicular outgrowths from adjacent medullary ray cells, and are found in all stages of projection into the tracheids. They are quite distinct from the tyloses which have long been known to be present in the resin ducts, and among the conifers seem to be confined to the genus *Pinus,* where they occur in all the species yet examined.

The Homologies of the Medulla in the Filicales: J. Horace Faull, University of Toronto.

Two views are held in regard to the medulla in the stems of the Filicales, one that it is of stelar, the other that it is of extrastelar origin. These two conceptions lead to two divergent views of the stele—to the two leading stelar hypotheses.

The author of this paper holds to the view that the medulla is of extrastelar origin—excepting the parenchymatous tissue that may appear in the center of the stele at the base of seedlings in certain cases. The following facts seem to favor the correctness of this view: (1) The similarity of cortical and medullary tissues. (2) Their continuity through foliar and ramular gaps. (3) The 'intrusion' of the cortex above the origin of leaf traces near base of many filicinean seedlings. (4) The actual enclosing of a portion of the cortex to constitute a pith at the base of adventitious shoots, where a protostele passes into the siphonostelic condition—here described for the first time, and apparently a direct demonstration of the point in question. (5) It has been shown recently that the meristematic areas at the growing point do not correspond to certain exact areas in the mature portion of the stem—thereby one of the arguments in support of opposing view is removed.

Polystely in the Orchidaceæ: J. H. WHITE, University of Toronto. (By invitation.)

Van Tieghem affirmed that the cauline steles of many plants repeatedly bifurcated, resulting in the phenomenon of polystely. He further affirmed polystely does not occur in roots, and that multistelic roots of many orchids result from the concrescence of monostelic roots.

His first statement has been disproved by Leclerc du Sablon, Jeffrey, etc.

The author of this paper takes up his second affirmation and shows that true polystely does exist in orchid roots, and that concrescence is not the correct explanation of the phenomena obtaining in them.

A large number of forms have been examined and conclusions have been based on the following facts: (1) The root apex is always covered by a single root cap, and at the tip a single primary dermatogen, periblem and plerome are to be found. (2) In some orchids the lateral roots are always monostelic. (3) In others they are monostelic at their base. (4) In the most complicated cases there are fewer steles at the base than farther out from the stem bifurcation of the steles is the rule. (5) The root initials consist of a single meristematic mass for each root, no indication of the concrescence of initials. (6) The ground tissue in mature roots show no signs of concrescence. (7) The roots in the youngest generations tend to be monostelic. An increasing complexity noted in succeeding generations. Certain forms examined lend support to the view that the medulla in some cases is of extrastelar homologies.

The Araucarieæ—A 'Proto-Siphonogamic' Method of Fertilization: ROBERT BOYD THOMSON, University of Toronto.

In my study of the megaspore membrane of the gymnosperms, supernumerary nuclei in the pollen tube of the Araucarieæ are referred to and the isolated position of the subgroup indicated. The ancient geological and the widely separated geographical distribution, the large microsporangiate cones in comparison with the megasporangiate, the evident transition between sporophylls and foliage leaves (points referred to recently by Professor Seward) are indications of an interesting and probably primitive group. The morphology and anatomy of the micro- and megasporophylls indicate that they are homologous structures, functionally differentiated. The microsporangium is fern-like. The microspore multicellular, and the pollen tubes

multinucleate (forty have been observed) as they grow in numbers over the sporophyll from their place of deposition, sometimes 3 cm. from the micropyle. Some penetrate the integument instead of entering the micropyle. There is no differentiation of a tube nucleus and only a single generative cell is present. For these reasons the Araucarieæ are considered by the author as proto-siphonogamic. There are indications also of a non-specialized embryogeny, intermediate in character between that of the cycads and of *Ginkgo*.

The Flowering Period of a Hybrid Opuntia: F. E. Lloyd, Desert Botanical Laboratory.

A Study of the Leaf-tip Blight of Dracæna fragrans: John L. Sheldon, West Virginia Agricultural Experiment Station. (Read by request before the Botanical Society of America.)

Tracy E. Hazen,
Secretary pro tempore

SCIENTIFIC BOOKS

Recherches expérimentales sur la Sexualité des spores chez les Mousses dioïques. Par El. et Em. Marchal. Mém. couronnés Cl. Sc. Ac. roy. Belgique, 2, I., 1906.

"A considerable number of plants are known in which a single egg gives rise by division to more than a single individual. Experimental investigations are demanded to determine if these individuals are always necessarily of the same sex." In response to this subject, thus recently proposed by the royal academy of Belgium, the Marchals have published the results of an interesting series of experiments on three diœcious mosses, *Barbula unguiculata, Bryum argenteum* and *Ceratodon purpureus.* Sowings were made from individual sporangia of these three species and, in the mixed growth resulting, both male and female plants were obtained. The conclusion thus reached that the capsule in these species contains both male and female spores was confirmed by sowings from single spores. Of five spores from a single capsule of *Bryum argenteum,* three gave rise to protonemata producing male and two to those producing female plants. Similarly, of seven single-spore sowings from a capsule of *Barbula unguiculata,* three spores produced male and four produced female plants exclusively.

Secondary protonemata, obtained by regeneration from stem, leaf or pieces of protonemata, as well as by germination of gemmæ, were of the same sex as the plants from which they were derived.

Attempts to influence the sex of protonemata by subjecting them to different external conditions were entirely unsuccessful. The effects of the following factors were tested: (1) Illumination. Cultures in strong and in weak, diffuse daylight and under red and under orange-colored glass. (2) Temperature. Three grades of temperature from 10 to 27° C. (3) Humidity. Cultures in saturated atmosphere and in an atmosphere as dry as consistent with growth. (4) Nutrition. A clayey sandy soil watered with solutions of different chemical composition. The nutrition experiments would have been more satisfactory if a substratum had been used which alone was not capable of producing an abundant moss vegetation as was the sandy clay employed. The experiments are sufficient, however, to show that the gametophytes of the mosses tested are strictly diœcious. Writers on the mosses have claimed that in diœcious species both sexes arise from the same protonema, but heretofore no careful study of the sexual differentiation in the mosses has been undertaken. Marchal's important experiments illustrate the value and necessity of the cultural method of investigation.

These three species of mosses studied by Marchal and the liverwort *Marchantia polymorpha* investigated by the reviewer (*Bot. Gaz.,* XLII., 171, Sept., 1906) are the only diœcious bryophytes for which the sexual character of the sporophyte is known. That these forms which are diœcious in the gametophyte are all hermaphroditic in sporophyte (heterothallic and homophytic according to a more precise terminology [*Bot. Gaz., l. c.*]) does not prove that this is the universal type

for diœcious Bryophytes. There is no *a priori* reason why in certain forms the sex of the whole sporophyte may not be determined in the zygote as is the case in the diœcious flowering plants and in *Mucor Mucedo*. The determination of the sex of the spores in a capsule apparently takes place at or but slightly before their formation. An attempt to suppress the formation of spores of one sex in the capsule would appear, therefore, more promising than attempts to change the sex of a spore or of a protonema already formed.

A. F. BLAKESLEE
CRYPTOGAMIC LABORATORY,
HARVARD UNIVERSITY

Le Mallatie Crittogamiche delle Piante Coltivate. DOTT. VITTORIO PEGLION, Professore die Biologia agraria nella R. Università di Bologna. 2a edizione, 1906. Casale Monferrato. 12mo., pp. viii + 323.

It is difficult for Americans to realize the great progress that is being made in Italy in the applied sciences. In botany, at least, few investigators take pains to acquire a working knowledge of the Italian language, and in consequence Italian work is best known to us through German and French reviews. The above work is a case in point: although issued over a year ago, no mention of it appears to have been made in any publication in the English language.

The book is one of a series now numbering somewhat over fifty—the Biblioteca Agraria Ottavi—all of which deal with some phase of technical agriculture, and in general represent the best Italian thought along their particular lines. No attempt has been made in this book to exhaust the subject of plant pathology, but the information contained is condensed and up to date: in many cases forming the best summary of knowledge on the given subject that the reviewer has seen in any language. But little attention is paid to mycology; the taxonomic position of the parasite does not determine the order of discussion; in other words, the book is written from the standpoint of the disease itself—making it almost unique among works on plant pathology. There is no index, but a very full table of contents; there are practically no illustrations. The book is printed in large, clear type, generally free from errors. In one place a curious transposition of paragraphs has occurred, which the author, *in litteris*, corrects as follows: the matter from and including the title 'La Peronospora del Frumento' on p. 96, to the beginning of the last paragraph on p. 97, should be interpolated between the second and third paragraphs of p. 93 following the words ' * * * come suol farsi.' Also the matter beginning at the bottom of p. 97 with the words 'Quando si approssima * * * ' and ending on p. 99 with ' * * * contestata da diversi studiosi.' should be interpolated on p. 102 before the words 'Quando una uredospora, od una * * * .'

The book opens with a chapter of generalities, after which two chapters are devoted to fungicides and the methods of applying them. A much greater number and variety of fungicides appear to be in common use than have been found practicable in America. It is interesting to note how, owing to field conditions, the knapsack type of sprayer is almost exclusively used. With cheap and efficient labor the results of such spraying should be, and apparently are, much better than those obtained here by the wholesale use of power and other large sprayers.

The remaining chapters are devoted to specific diseases of the following plants: wheat, oats, barley, corn, rye, rice, alfalfa, beans, peas, potatoes, beet, cabbage, turnip and other cruciferæ, hemp, flax, tobacco, watermelon, strawberry, onion, tomato, grape, pear, apple, peach, plum, olive, citrous fruits, mulberry. Three chapters are devoted to diseases attacking plants in the seed-bed, to the treatment of wounds, and to the various forms of root-rot of trees. It is unfortunate that the author has not seen fit to include some bibliographical matter under these various heads; or at least to bring Voglino's bibliography (1895) down to date.

This book is of especial interest to American plant pathologists at this time on account of its discussion of the diseases of the semi-tropical plants, largely untreated in other

general works. It amply merits translation into English and other languages.

Haven Metcalf
U. S. Department of Agriculture

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for January contains the following articles: 'Note on the Habits of Fierasfer,' by Edwin Linton, describing the manner in which the fish enters tail first the body of a holothurian. 'Records of Pennsylvania Fishes,' by Henry Fowler, giving definite localities for many species. 'Specific Name of *Necturus maculosus*,' by F. C. Waite. Tetradactylus is unavailable as a specific name, not because it refers to a generic character, but because it was not applied as a scientific name; what Lacépède wrote was *Protéetétradactyle*. Under 'Volvox for Laboratory Use,' Bertram G. Smith tells how it may be kept and J. A. Cushman records seven species of 'Ostracoda from Southeastern Massachusetts.'

The Museum's Journal of Great Britain has for its leading articles 'How to Promote Interest in Museum Collections,' by H. Conwentz, and 'Children and the Cult of the Beautiful,' by Beatrice V. Vernon. The first applies particularly to what may be termed local museums, and we doubt if many of the suggestions would prove to be practicable in a large institution. Miss Vernon's article deals largely with art museums and Mr. Harlan I. Smith will find in it methods akin to his interrogative label.

The Zoological Society Bulletin for January is an unusually good number. We can only note among other articles those on 'The Goat Herd,' 'An Almost Extinct Bird' (the California Vulture), the 'African Vipers,' 'The Frigate Birds' and 'Collecting for the Aquarium.' It is announced that the last of the large buildings are expected to be completed by the end of 1908, and that the attendance for the year was 1,300,000. A green turtle received at the aquarium weighed 540 pounds; the length of the upper shell was 4 feet 6 inches. It may be seen from this how large a thousand-pound turtle would be. The attendance at the aquarium during 1906 was something over 2,000,000.

The Museum News, of the Brooklyn Institute for February announces the installation of a group of Atlantic walrus. The principal article in the Children's Museum section is on the muskrat and states that in the Hackensack marshes the muskrats seem to live in houses throughout the year, the summer houses being more loosely built than the winter home.

The Fortnightly Review for January contains an article by E. Ray Lankester describing in some detail the work carried on at the British Museum during the past eight years under his immediate supervision.

SOCIETIES AND ACADEMIES

THE ST. LOUIS CHEMICAL SOCIETY

At the regular meeting of the society on January 14, Mr. A. H. Kelling presented a paper entitled 'Sewage Purification.' Pollution of water supplies, and the danger of infection resulting from the habits of the house fly, were dwelt on as showing the importance of the subject. The three methods by precipitation, by means of sewage farms, and by means of septic tanks and filtration were then treated in considerable detail. After the discussion, which followed the presentation of this paper, Dr. Andrews presented a paper, which favorably discussed the probable appearance of some official interpretations of certain regulations contained in the last issue of the U. S. Pharmacopœia, with reference to the Pure Food and Drugs Act.

C. J. Borgmeyer,
Corresponding Secretary.

DISCUSSION AND CORRESPONDENCE

GENETIC LOGIC

To the Editor of Science: Dr. Tawney's criticism of my book on 'Genetic Logic,' in your issue of February 1, calls for a word or two of comment.

He is mistaken in supposing the 'dualism of control' as I develop it represents my own view of the nature of reality.

Being the 'knower's logic' that I am de-

veloping—a matter made so explicit that the phrase is coined to express it—it is strictly the *knower's point of view* from which such a dualism is depicted. I aim to trace the natural history of the naïve dualism of knowledge inside the consciousness that has it. My motive in saying this here is not so much to meet this criticism as the wish to explain an ambiguous phrase I have employed in the book. I speak of 'foreign control' as of something 'foreign to the process itself' (of knowledge). What I mean is *'seeming to the process itself to be foreign,'* not *'seeming to the writer to be foreign to or apart from the process.'* There is a real ambiguity in the phrase, and I am herewith calling attention to it. Others may be misled by it.

Dr. Tawney also says that many of the 'objects' I distinguish are not such from the knower's point of view; implying that by using that phrase I limit the 'knower's logic' to process having a self-conscious knower, that is, to consciousness of *the self-knowing or reflective type.* On the contrary, I use 'knower' for any process that has knowledge, as is customary; the dog, the worm, the mollusc is a 'knower' so far as it knows anything; indeed, I have gone to excessive pains to say that I treat of cognitive meanings from the point of view of *the process that has them —the psychic point of view.* How and with what *psychic meaning* there arise objects of knowledge in a progressive series, it is the main problem of my book to discuss. It begs the whole question to assume that there is no knowledge except that which *knows the self.* With the conclusions one may differ, but the doctrine should be clearly expounded.

Finally, a word in ethics. It is a writer's duty sometimes to help the critic understand his views; for a real embarrassment may arise to one who fears to criticize, lest the criticism, though possibly due to misinterpretation, may yet seem to misrepresent and so to have upon it the taint of intellectual dishonesty. I myself have sometimes felt in studying a book that if I knew the writer's own real mind to be or not to be what I take it to be, I should feel more free in criticizing him; for, of course, if a critic does know better, misrepresentation is dishonest. So though in itself a point be hardly important enough to require attention, yet the author may have the duty of aiding those who take interest in his work.

J. MARK BALDWIN
JOHNS HOPKINS UNIVERSITY,
February 3, 1907

SPECIAL ARTICLES

SYMMETRY IN BIG CLAWS OF THE LOBSTER

THE lobster is probably the most widely known of living crustacea, as it is one of the largest, and most eagerly sought for food. Few who have seen it have failed to notice that the great 'forceps' or big claws are unlike, the larger, which weighs from one quarter to one half as much as the entire animal, having crushing tubercles, while the smaller and slenderer is armed with tooth-like spines. The toothed, or 'quick,' claw, which is a 'lock-forceps' with serrate jaws, is used for seizing and holding, and the larger crushing, or 'club,' claw for rending and crushing the prey.

The large claws occur about as frequently upon the right as upon the left side of the body, and without distinction of sex, but as I have shown to be the case with the shrimp *Alpheus,* in which the asymmetry and inequality of the great chelæ are even more marked, this condition is probably one of direct inheritance, all members of a brood being either right-handed or left-handed. That is to say, the normal position of the toothed or crushing claw is not haphazard, but is predetermined in the egg.

In 1895 I described a variation in the American lobster[1] (*Homarus americanus*) in which both the big chelæ were similar, and of the toothed type. This variation was exceedingly rare, only three cases having been found in a collection of 2,430 lobsters made by Mr. Vinal N. Edwards, the naturalist and collector of the U. S. Fisheries' laboratory at Woods Hole, Massachusetts.

Since that time several papers have appeared upon this subject, notably by Stahr,[2]

[1] 'The American Lobster,' Bull. U. S. Fish Comm., 1895, p. 143.

[2] *Jenaischen Zeitschrift f. Naturwiss.,* 33 Bd., 1898.

who found this variation of similar toothed claws much more common in the European lobster. The history of development proves, as Stahr upon theoretical grounds maintained, that the toothed claw represents the more primitive, and the crushing claw the more modified, type. It, therefore, seemed natural to infer, as he did, that the anomalous symmetry in these weapons had been brought about by loss of a crushing claw, and subsequent reversion to the primitive toothed condition in the regenerated member which took its place. This would give us a lobster with symmetrical toothed claws like the variation described.

The converse of this, or the production of a new crushing claw in place of a toothed 'forceps' could not occur upon Stahr's theory of regeneration, and hence he inferred that my report of a case of *similar crushing* claws in a lobster was an error. Herr Stahr is not to be blamed, for this report was based upon the statement of a fisherman. Yet, however great the unreliability of this class of men in biological matters, I have yet to find a 'lobsterman' who could not tell a 'club' from a 'quick' claw. It now seems that the maligned fisherman was right, and he should get his dues, while Herr Stahr's theory will have to be revised, for Dr. W. T. Calman, of the British Museum, has recently described[1] a case of symmetrical crushing claws in the British lobster (*Homarus gammarus*), and his account is accompanied by an excellent photograph. In all other respects this animal was a perfectly normal male. It was caught near Stromness, Orkney, and its living weight was four pounds ten ounces.

In a letter regarding this unique specimen Dr. Calman says:

> The correspondence between the two chelæ as regards arrangement and size of the crushing tubercles is even closer than appears on the photograph, where slight differences of color have a little obscured the shape in one or two points. The differences are no greater than one would expect to find between the two sides of a normally symmetrical animal. In other respects the chelipeds are practically alike in size and shape, except that, as seen on the figure, the dactylus of the left is shorter than that of the right. The basal segments of the limbs show no trace of asymmetry which is often associated with regeneration.

The shrimp *Alpheus* carries a huge 'hammer,' or snapping, claw, which in some species is as large as the entire body of the animal, and a diminutive claw of more primitive form on the opposite side. Moreover, in the common *Alpheus heterochelis* of the southern coast the small chela presents an interesting sexual variation of which I have drawings and notes made in 1893, but about which nothing had been published until the appearance of Wilson's interesting studies on the 'Reversal of Asymmetry in *Alpheus*' in 1903. The small chela of the male resembles the 'hammer' more closely than does the corresponding simpler and more primitive claw of the female.

A remarkable example of heteromorphic regeneration or reversal of asymmetry is seen when the *Alpheus* 'shoots' its 'hammer,' or for any cause loses its big claw, as was discovered by Prizibram in 1891. The big claw seems to hold the little one in check, for no sooner is it lost than the smaller one grows apace, and becomes differentiated into a 'hammer' or a 'snapper,' while in compensation for this change a diminutive chela of the primitive type replaces the great claw lost from the opposite side. Wilson found that in both sexes the small claw, which was regenerated from the stump of the large one, was always of the simpler female type, and, moreover, that the small chela of the male was more rapidly changed into the big 'pistol' or 'hammer' claw because it was already farther advanced on this line of development than that of the female. When the smaller claw is amputated, or when the 'forceps' are removed from both sides of the body at once, there is no reversal, a new cutting chela or hammer claw taking the place of the corresponding member lost. Many additional facts have been brought to light through the experimental studies of Wilson, Brues and Zeleny.

In the lobster no reversal or compensatory regulation normally or usually attends the re-

[1] In *Proceedings of the Zoological Society of London* for 1906.

generation of any of its appendages. The crushing or the toothed forceps, when severed at the 'breaking plane,' are replaced by their like in due time after one or more molts. How, then, are we to explain the anomaly of similar claws? It seems highly probable that the reversal, which regularly takes place in *Alpheus* when its great 'hammer' claw is cut off, does actually occur, though but rarely, in the lobster, or rather that it involves one side only, there being no immediate compensatory change to restore equilibrium of the system of which the great claws form a part. Thus, when a 'club' claw is 'shot' or amputated by the experimenter, a chela of similar crushing type is usually regenerated in its stead, but rarely a toothed claw appears. There is a reversal of the appendage, bringing about an abnormal condition of symmetry, but the process stops here, and we have as the result lobsters with similar toothed claws, like the specimen illustrated in my earlier work referred to above.

In like fashion the toothed claw of the lobster is usually replaced in regeneration by a limb of similar type, as is the rule with *Alpheus,* but in rare cases a reversal occurs here also; a 'club' claw appears, and we get a lobster with symmetrical crushing chelæ, like the specimen described by Dr. Calman. As this case is, for the present, essentially unique in the literature of the subject, we may be sure that it is much rarer than reversal from crushing to toothed claws. There is the possibility that these abnormal conditions of symmetry may be upset by a compensatory change in the appendage of the opposite side, but there is no evidence at present that this ever takes place.

In the first case the reversal from crushing to toothed claw happens to reproduce the primitive form of limb, but we see no reason for regarding this as a case of reversion to an ancestral stage, in the sense in which Stahr uses the phrase.

The explanation just offered is based on the assumption that regeneration, following loss, actually occurs in these cases. If there has been no regeneration, we must then fall back upon the view that as asymmetry in the great forceps is normally produced by changes which take place in the egg, so the rare condition of symmetry in these appendages may be casually brought about in the same way.

FRANCIS H. HERRICK
BIOLOGICAL LABORATORY,
WESTERN RESERVE UNIVERSITY

CURRENT NOTES ON METEOROLOGY

THE WEATHER OF SAXONY

THAT portion of the *Deutsches Meteorologisches Jahrbuch* for 1902 which relates to the kingdom of Saxony (Dresden, 1906) contains a discussion of the special observations made at the meteorological stations in that section with a view to furnishing information regarding the general weather conditions, for use in forecasting. In addition to the regular observations made thrice daily, the observers note the prevailing type of weather during the morning, afternoon and evening, according to a scale of ten. These types differ somewhat in summer and in winter. They are simple; are noted by means of symbols, and have been found to serve very well in giving the forecaster an excellent general view of the prevailing weather over the kingdom. Such a scheme might well be adopted among the volunteer observers in this country and elsewhere, and would often serve to give a clearer idea of the weather conditions than do the regular meteorological observations taken twice a day. A second paper, on the dependence of weather in Saxony on the prevailing weather conditions of Europe, will be found useful in detailed studies of European climatology.

RAILROAD BUILDING IN ARID REGIONS

THE climatic difficulties now being met with in the construction of the new railroad between Damascus and Mecca are naturally similar to those previously encountered in other arid regions. The main line is being built across a desert highland where for hundreds of miles there are no permanent human settlements within thirty to fifty miles of the track. The country from Damascus to Medina is inhabited only by small bands of nomadic Bedouins. The scarcity of water is giving serious trouble. Some new artesian wells

have been sunk, but all water for drinking and cooking purposes, and for preparing mortar, is carried in water cars. The expense of construction is thus greatly increased. All fuel has to be imported, but owing to the high temperatures little is required except for the locomotives and the repair shops.

METEOROLOGY IN EGYPT

Captain H. G. Lyons, Director General of the Survey Department of Egypt, gives an encouraging account of the present status of meteorological work in Egypt in his 'Report on the Work of the Survey Department in 1905' (Cairo, 1906). There are in Egypt ten stations and in the Sudan sixteen stations. The locations are shown on a map. There are also a number of river gauge stations. The central meteorological station at Helwan, of which a picture is given, is an attractive building, lighted by electricity, and equipped with standard instruments. Captain Lyons has already published several reports of unusual value on the meteorology of the Nile Basin, especially in connection with the Nile floods.

RAINFALL AND ALTITUDE

Hann calls attention (*Met. Zeitschr.*, Nov., 1906) to the results of rainfall measurements made in connection with the water supply of the city of Edinburgh, in the district of the upper tributaries of the Tweed. Under similar conditions of exposure, but at different altitudes, the rain-gauges show on the average an increase of 2.5 inches of rainfall in each 100 feet of increase of elevation.

THE 'SCOTIA' RESULTS

Mention has several times been made in these notes of the meteorological results of the *Scotia* Antarctic expedition, these notes being based on short reports which have appeared in scientific journals. There has lately been published 'The Voyage of the *Scotia*,' by three of the staff (Edinburgh, Blackwood, 1906), which gives a popular account of the expedition, as well as a summary of the scientific results obtained.

R. DeC. Ward

MR. ROCKEFELLER'S GIFT TO THE GENERAL EDUCATION BOARD

Mr. John D. Rockefeller has announced his intention to give, not later than April 1, securities valued at about $32,000,000, to the General Education Board, which he had previously endowed with $11,000,000. The letter announcing this gift, read at a meeting of the board on February 7, is as follows:

New York, Feb. 6, 1907.

General Education Board, 54 William Street,
New York City.

Gentlemen: My father authorizes me to say that on or before April 1, 1907, he will give to the General Education Board income-bearing securities, the present market value of which is about thirty-two million dollars ($32,000,000), one third to be added to the permanent endowment of the board, two thirds to be applied to such specific objects within the corporate purposes of the board as either he or I may, from time to time, direct; any remainder not so designated at the death of the survivor to be added also to the permanent endowment of the board.

Very truly,

John D. Rockefeller, Jr.

The board has acknowledged this great gift in the following terms:

The General Education Board acknowledges the receipt of the communication of February 6, 1907, from Mr. John D. Rockefeller, Jr., a member of this body, announcing your decision to give to the board for the purpose of its organization, securities of the current value of $32,000,000. The General Education Board accepts this gift with a deep sense of gratitude to you and of responsibility to society. This sum, added to the $11,000,000 which you have formerly given to this board, makes the General Education Board the guardian and administrator of a total trust fund of $43,000,000.

This is the largest sum ever given by a man in the history of the race for any social or philanthropic purpose. The board congratulates you upon the high and wise impulse which has moved you to this deed, and desires to thank you, in behalf of all educational interests whose developments it will advance, in behalf of our country whose civilization for all time it should be made to strengthen and elevate, and in behalf of man-

kind everywhere, in whose interests it has been given and for whose use it is dedicated.

The administration of this fund entails upon the General Education Board the most far-reaching responsibilities ever placed upon any educational organization in the world. As members of the board, we accept this responsibility, conscious alike of its difficulties and its opportunities.

We will use our best wisdom to transmute your gift into intellect and moral power, accounting it a supreme privilege to dedicate whatever strength we have to its just use in the service of men.

It is said that Mr. Rockefeller's gifts to education now amount to about $80,000,000.

The General Education Board has so far made appropriations, amounting to more than $1,000,000, to eighteen colleges on condition that three times the amount appropriated should be obtained by the institutions from other sources. At the meeting of the board, on February 7, the following appropriations, as we understand on the same conditions, were made: Beloit College, Beloit, Wis., $50,000; Morningside College, Sioux City, Iowa, $50,000; Lafayette College, Easton, Pa., $50,000; Wabash College, Crawfordsville, Ind., $125,000, and the University of Wooster, Wooster, O., $125,000.

SCIENTIFIC NOTES AND NEWS

PROFESSOR ERNEST W. BROWN, who this year goes from Haverford College to Yale University, has been awarded the J. C. Adams prize of Cambridge University, for his work on the motion of the moon.

PROFESSOR WILHELM VON BEZOLD, professor of physics and meteorology at Berlin, and Professor Theodor Boveri, professor of zoology and comparative anatomy at Würzburg, have been elected corresponding members of the St. Petersburg Academy of Sciences.

PROFESSOR W. M. DAVIS, of Harvard University, has been elected foreign correspondent of the Geological Society of London.

IN celebration of the twenty-fifth anniversary of the coming to Lehigh University of Professor Joseph F. Klein a reception was given him in South Bethlehem on the evening of January 22.

AT the annual general meeting of the Royal Meteorological Society, Mr. Richard Bentley, the president, on behalf of the members of the council, presented an illuminated address to Mr. William Marriott, in recognition of his services as lecturer for the society.

THE following committee has been appointed by the president of the Washington Academy of Sciences to take charge of the arrangements for the entertainment of the International Zoological Congress during its visit to Washington after the adjournment of the Boston meeting in August, 1907: L. O. Howard, chairman, Frank Baker, W. H. Dall, H. G. Dyar, B. W. Evermann, Theodore N. Gill, H. W. Henshaw, C. L. Marlatt, A. D. Melvin, C. Hart Merriam, T. S. Palmer, B. H. Hanson, Richard Rathbun, Robert Ridgway, H. M. Smith, Leonhard Stejneger, C. W. Stiles, F. W. True, T. Wayland Vaughan, C. D. Walcott.

SECRETARY TAFT will, it is said, appoint a committee, consisting of Charles F. McKim, the architect; Frederick L. Olmstead, Jr., of Boston, landscape gardener, and Frank D. Millett, the artist, to go to Niagara and gather material for a report looking toward harmonizing the commercial buildings there, particularly the power plants, with the natural scenery.

PROFESSOR J. C. ARTHUR and Mr. F. D. Kern, both of Purdue University, Lafayette, Indiana, continued their researches on plant rusts in the New York Botanical Garden herbarium during the month of January. Dr. M. T. Cook has been awarded a research scholarship at the garden for three months, beginning on January 1.

A CABLEGRAM to the daily papers from Calcutta states that news from Dr. Sven Hedin, the Swedish traveler, who last year started from Chinese Turkestan on a journey of exploration to Tibet, has been received. Dr. Hedin, who, when he sent off his courier, had already explored 840 miles of unknown country, said he hoped to reach the monastic city of Shigatse, 130 miles from Lhasa, at the end of February.

The eighth lecture in the Harvey Society course was given by Professor George Huntington, of Columbia University, at the New York Academy of Medicine on Saturday evening, February 9, on 'The Genetic Interpretation of the Variations in the Genito-Urinary Tract.'

On January 15, Professor W. E. Castle delivered an address before the American Breeders' Association, at Columbus, Ohio, on the subject, 'The Production and Fixation of New Breeds.'

Professor R. DeC. Ward, of Harvard University, gave an illustrated lecture on 'Clouds: their Formation, Classification and Value as Weather Prognostics,' before the Contemporary Club of St. Louis on February 1; before the Society of Pedagogy of St. Louis on February 2, and before the pupils of the St. Louis Central High School on February 4. He also gave an informal talk before the Science Section of the Wednesday Club of St. Louis on February 4.

Dr. Charles E. Garman, professor of philosophy at Amherst College, died on February 9, at the age of fifty-seven years.

Dr. P. J. Möbius, the author of books on various pathological, psychological and sociological subjects, has died at Leipzig at the age of fifty-three years.

It is expected that there will be a vacant fellowship, and perhaps two vacant fellowships, at the Lick Observatory, University of California, for the academic year beginning July 1, 1907. If the holder of a fellowship desires to pursue studies leading to the degree of doctor of philosophy, he will be expected to reside on Mount Hamilton during eight months of the year and in Berkeley during four months of the year. If the appointee has already taken his doctor's degree, he will probably reside on Mount Hamilton during the entire year. The stipend connected with each fellowship is $600 per annum. Applicants should address The Director, Mount Hamilton, California.

Professor Charles Lane Poor and others appeared before the legislative committee on February 5 to argue in favor of Assemblyman Young's bill to incorporate the New York Observatory and Nautical Museum, and to empower the Board of Estimate and Apportionment in its discretion to enter into an agreement with the corporation for the erection by the city in one of the public parks of suitable buildings, which the corporation is to equip with instruments and collections of nautical science for public exhibition and research.

UNIVERSITY AND EDUCATIONAL NEWS

The seventy-fifth anniversary of the foundation of Lafayette College will be celebrated from June 16 to 19 of the present year. An effort is being made to celebrate the anniversary by the collection of an endowment fund of $500,000. Of this fund more than $325,000 has been secured, and Mr. Andrew Carnegie, who has given $50,000, has also promised to give the last $50,000 of the full sum of half a million.

Mr. Andrew Carnegie has given $40,000 to Yale University for a swimming pool.

The trustees of the University of Illinois will ask the legislature for the sum of $1,600,000, in round numbers, for the running expenses of the university during the coming biennium and for $62,000 for increase in the plant. It has also decided to ask for a special appropriation of $1,000,000 for the erection of much needed buildings upon the campus in Urbana. It has, furthermore, decided to ask for $385,000 for the erection or purchase of buildings to house adequately the medical department in the city of Chicago.

At Columbia University Dr. Dickinson S. Miller, now lecturer in philosophy, has been made professor of philosophy, and Dr. Gary N. Calkins, now professor of invertebrate zoology, has been made professor of proto-zoology.

Dr. Donald MacAlister, fellow and director of medical studies of St. Johns College, Cambridge, has been appointed principal of Glasgow University.

Dr. Georg Klebs, of Heidelberg, has been called to the chair of botany at Halle, vacant by the death of Professor E. Pfitzer.